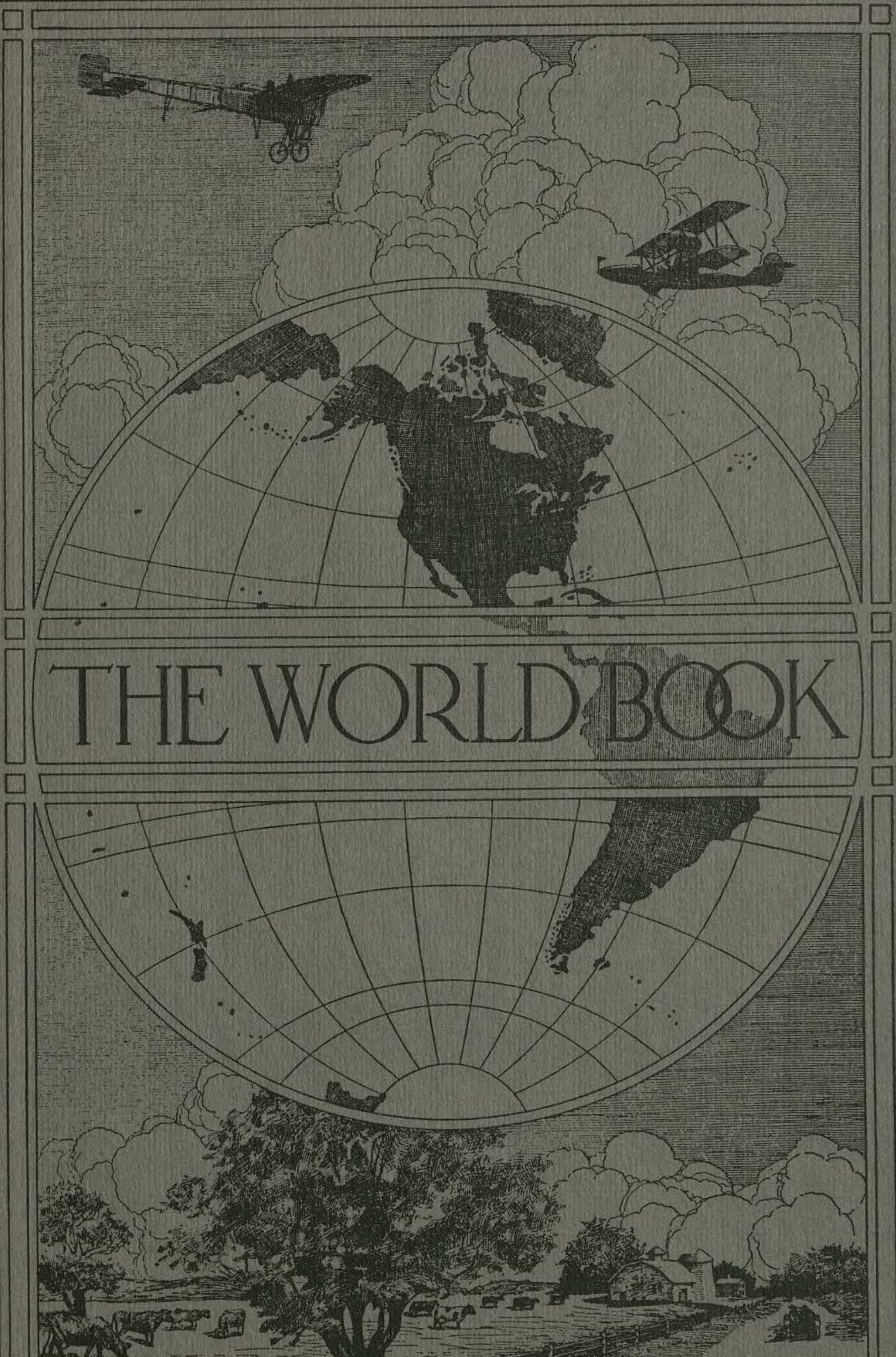
THE WORLD BOOK



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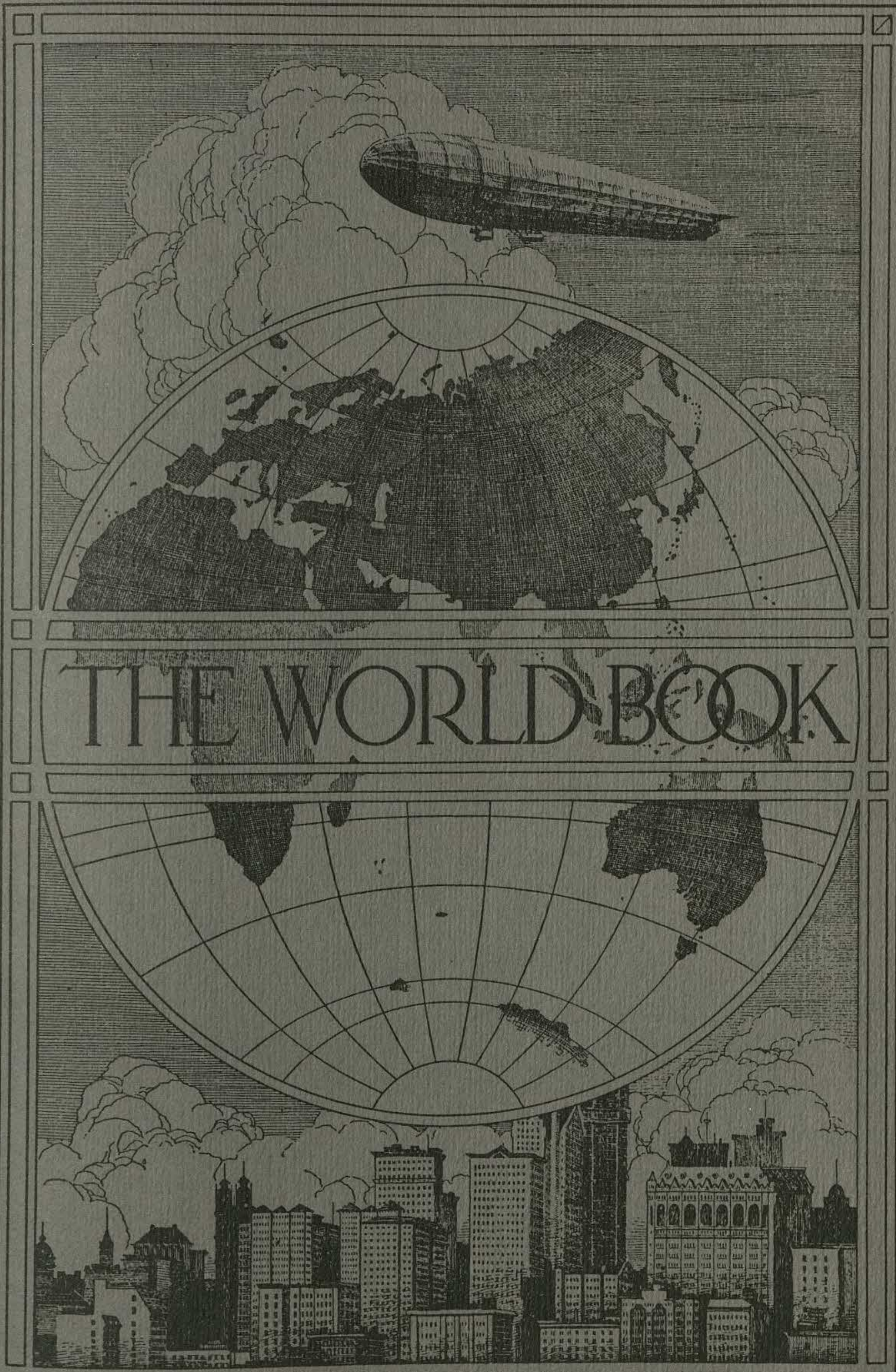
THE WORLD BOOK

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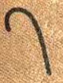
Ll

L is the 12th letter of the English alphabet. It was also a letter in the alphabet used by the Semites, who once lived in Syria and Palestine. They named it *lamed,* their word for *goad,* or *crooked staff.* They adapted an Egyptian hieroglyphic, or picture symbol, for goad, to represent the letter. The ancient Greeks took the letter into their alphabet and called it *lambda.* Later, the Romans borrowed it from the Greek alphabet and gave the letter its present capital L form. See **Alphabet.**

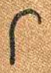
Uses. *L* or *l* is the 11th most frequently used letter in books, newspapers, and other printed material in English. *L* is the Roman numeral for *50.* When it is written with the crossbar, as £, it is the sign for pound in English money, and comes from the Latin word *libra,* or *pound.* In physics, *L* stands for *length,* as it does in most measurement formulas. In geography, *L* indicates *longitude,* and *l* stands for *latitude.* The *l* also stands for *lira* in Italian money; for *leaf* in describing books, and for *left* as in *l.f.,* or *left field;* and for *lower* as in *l.c.,* or *lower case,* a term used in typography and journalism.

Pronunciation. In English, *l* is pronounced by placing the tongue tip against the gum just above the upper front teeth. The tongue is spread so that it touches the upper teeth on both sides. The breath stream causes the vocal cords to vibrate and passes out of the mouth on one side of the tongue or the other. The *l* is silent in *would, should, salmon,* and *half.* In Spanish dialects, *ll* sounds like *ly.*

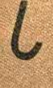
Development of the letter L



The ancient Egyptians, about 3000 B.C., used a symbol that represented a crooked staff called a *goad.*



The Semites adapted the Egyptian symbol about 1500 B.C. They named it *lamed,* which was their word for *goad.*

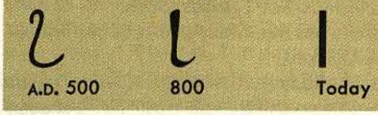


The Phoenicians used a symbol of an upside-down staff about 1000 B.C.

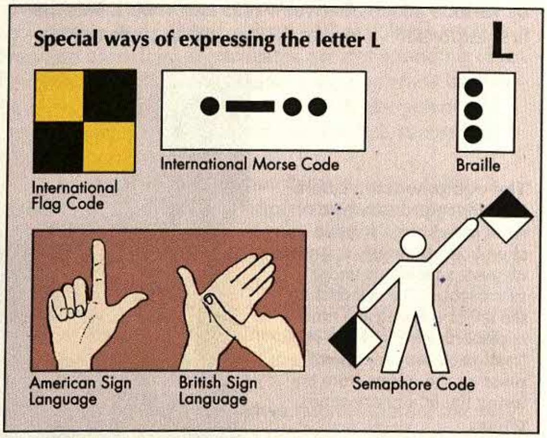
The Greeks added the letter to their alphabet about 600 B.C. They called it *lambda* and wrote it as an inverted V.

The Romans gave the letter L its present shape about A.D. 114.

The small letter l appeared during the A.D. 500's. Writers gradually dropped the horizontal stroke, and, by the 800's, the letter had developed its present shape.



Special ways of expressing the letter L



Common forms of the letter L

Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.

Ll *Ll*

Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears on the right.

Ll *Ll*

Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears on the right.

L

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

Labelling. See **Bar coding.**
Labium. See **Insect** (Mouthparts).
Labor Party. See **Australian Labor Party.**

Laboratory is a place equipped with apparatus for conducting scientific experiments, investigations, and tests. Many devices and products used in everyday life resulted from laboratory work. They include car engines, plastics, radios, synthetic fabrics, telephones, television sets, and transistors. Laboratories may be found in universities, in research institutes and industrial organizations, and in government departments. They serve as a training ground for scientists and a means for discovering new knowledge.

Most scientists, and many engineers, work in laboratories. Research students, preparing a PhD thesis, also work in laboratories and are involved in original research. Laboratories employ many other people, such as laboratory assistants, technicians, instrument builders, administrators, and clerical workers.

Scientists perform two types of research: fundamental or basic research and applied research. In fundamental research, scientists look for explanations of natural phenomena and search for new natural laws. Scientists that do applied research concentrate on the development of new or better devices, or new chemical compounds, often using the results of fundamental research. University laboratories concentrate more on fundamental research, while most industrial laboratories are involved in applied research.

See also **Chemistry** (The work of chemists); **Science** (How scientists work).

Labour, in birth. See **Childbirth.**
Labour, in economics. See **Labour force.**
Labour, Division of. See **Mass production; Trade** (Trade and specialization).

Labour Day is a holiday in Australia and New Zealand. In Australia, people also call it *Eight-Hour Day* because it marks the achievement of an eight-hour working day by various groups between 1855 and 1900. It was the first important victory of the Australian trade unions.

In New South Wales, Labour Day is celebrated on various days in different parts of the state. In Queensland, it is May 1 or the following Monday; in South Australia, the second Monday in October; in Victoria, the second Monday in March; and in Tasmania and Western Australia, the first Monday in March. In New Zealand, it is celebrated on the fourth Monday in October.

Labour force is the part of a nation's population that works for pay or is actively seeking work. The labour force produces most of a nation's goods and services, and its size and productivity help to determine that nation's economic growth.

The United Nations (UN) uses the term *economically active population* instead of *labour force.* The economically active population consists of people of all ages who are employed or looking for jobs. The percentages of teenagers and old people in this group are much higher in many developing countries.

Economists sometimes use the term *human resources* for the total number of people available to work if needed. During World War II (1939-1945), for example, many people not normally in the labour force took jobs in factories doing war work.

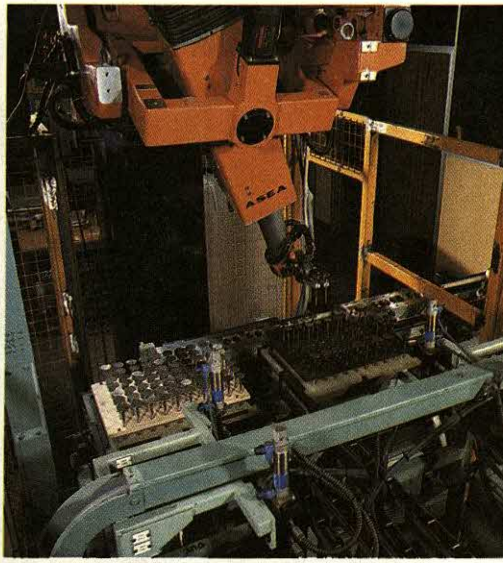
Changes in the labour force. The two world wars of the 20th century had an important effect on the number of women in the work force of combatant nations. Many women went to work for the first time during these wars.

The percentage of women in the labour force has increased greatly in the last 100 years. For example, in 1890, women made up 17 per cent of the American work force. By 1950, this figure had reached 29 per cent. By 1990, it was over 43 per cent.

Women have joined the labour force because of changing social attitudes, rising divorce rates, declining birth rates, and higher wages. Many women now work in *white-collar jobs.* These jobs include business, clerical, and professional positions.

In the European Community (EC) in the late 1980's, the economically active proportion of the population was 44

The equipment in a laboratory depends on the type of work being done. In a biochemical laboratory, scientists observe specimens under a microscope. The scientist on the left is working at a fume cupboard, which has an extraction system to prevent poisons and germs from entering the laboratory atmosphere.



Changes in technology have reduced the number of people working in factories. An assembly line of the 1950's, *left,* employed a large team of workers to make bicycle components. Today, industrial robots, *right,* have replaced humans in many industries.

per cent, lower than in the United States, and Japan (49.9 and 49.8 per cent respectively). In Japan, more men work beyond the age of 65. The figures for economically active women were: European Community 33 per cent, Japan 39 per cent, and United States 43 per cent.

In most developed nations the number of people joining the labour force began to decline in the 1980's. This drop was caused by the fall in the birth rate in these countries. In countries with rising birth rates, the number of people joining the labour force, though not necessarily able to find employment, is expected to increase. Finding jobs for young people, and retaining older workers who need to learn new skills as industrial technologies change, is a major challenge for governments in the 1990's.

See also **Unemployment.**

Labour legislation. See **Child labour; Strike.**

Labour-management relations. See **Industrial relations.**

Labour Party is a political party that was first established in Britain to promote socialist policies. The British Labour Party is one of the country's leading political parties. Many other countries also have a Labour Party. This article is mainly about the British and Irish Labour Parties.

The British Labour Party aims to maintain the freedom of individuals while carrying out sufficient planned public (state-run) enterprise to fulfil certain social objectives. These objectives are that all members of the community should have both the opportunity and the obligation to contribute to the production of wealth, and that the wealth produced should be distributed justly.

This policy is known as *democratic socialism.* The principles and policies of the British Labour Party are similar to those of other democratic socialist parties in Europe and in other parts of the world.

The Labour Party's official colour is red, a colour adopted by many movements of protest, which consider it the symbol of the common bond of all human beings. The Labour Party has adopted a red rose as its symbol.

Defence. The Labour Party supports collective security among nations. The party supports defence alliances such as the North Atlantic Treaty Organization (NATO), and also urges support for the United Nations in settling international disputes. The party believes that Britain should retain a limited stock of nuclear weapons while talks on disarmament continue.

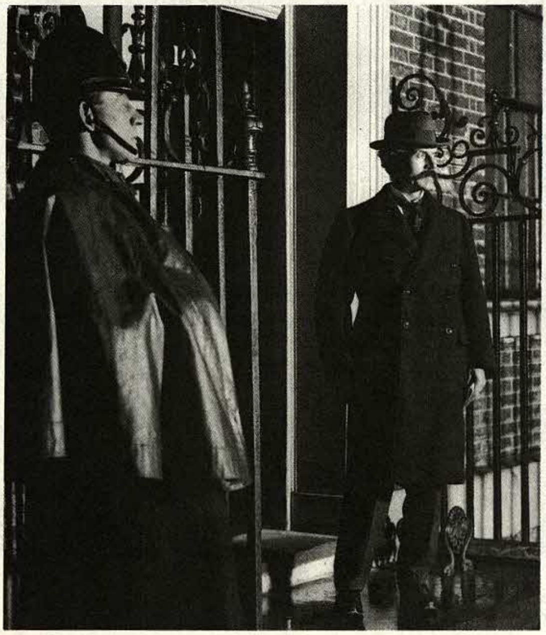
Economics. In the 1990's the Labour Party moved away from its former support of wider government ownership and control of land and of utilities such as gas and electricity. It advocates greater spending on industrial investment and training, through new bodies such as a national investment bank. It also advocates higher government spending on welfare services and environmental protection.

Home policy. The Labour Party aims to achieve a community in which all people have equal opportunity. The Labour government of 1945 to 1951 greatly expanded the national insurance system to provide financial assistance for the aged, the sick, and widows. The Labour Party is committed to the support and improvement of Britain's state-financed national health service, and also of the rights of children, women, and ethnic minorities.

The Labour Party also advocates a separate elected assembly for Scotland, and reform of the House of Lords.

In education, the Labour Party adopted the policy in the 1960's of ending the division between grammar schools and secondary modern schools in the national education system.

History. In 1900, a group of trade unions, cooperative societies, and socialist societies formed the Labour Representation Committee in order to establish a Labour



Ramsay Macdonald arriving at No 10 Downing Street, London, in 1924, as the United Kingdom's first Labour prime minister.

group in Parliament. In 1906, with 29 Labour members of Parliament, the committee changed its name to the *Labour Party.*

In 1924, Ramsay MacDonald formed the United Kingdom's (UK's) first Labour government. His second government, formed in 1929, resigned in 1931, after failing to ease unemployment. The UK's third Labour government lasted from 1945 until 1951, with Clement Attlee as prime minister. In 1955, Hugh Gaitskell succeeded Attlee as leader. Gaitskell's successor, Harold Wilson, led Labour to power in 1964, and he served as prime minister until 1970. In 1974, Labour returned to power, again with Wilson as prime minister. In 1976, Wilson resigned and Jim Callaghan became party leader and prime minister. The Labour government lost power in 1979. Callaghan resigned in 1980 and Michael Foot became party leader.

After its 1979 election defeat, the Labour Party suffered internal conflicts over policy and constitutional organization. Left-wing members favoured more radical socialist policies and greater party control by constituency branches and trade unions. Right-wing party members opposed these changes because they felt that British people would not accept radical socialism. A group of right-wing members resigned from the Labour Party in 1981 and formed the Social Democratic Party. Labour lost another election in 1983, and Foot resigned. He was succeeded by Neil Kinnock. Labour lost a further election in 1987. In 1992, Labour failed once more to win the election and Neil Kinnock resigned from the party leadership. John Smith became the party leader. Under Smith's leadership, the party's unity grew, and delegates at the 1993 Labour Party conference voted to reduce the power of the *union block vote.* Before this change, some parliamentary candidates had been chosen by union representatives who voted on behalf of their members. Smith died in 1994. Tony Blair won the vote to become the new party leader.

The Irish Labour Party has its origins in trade unionism. It was founded in 1912 by James Connolly as a congress of Irish trade unions. From 1921 until 1927 it was the main opposition party.

The Irish Labour Party has been in government a number of times since the 1950's, by joining in coalition with another party, Fine Gael. Since the 1960's, the Irish Labour Party has been led by Brendan Corish (1960-1977), Frank Cluskey (1977-1981), Michael O'Leary (1981-1982), and Dick Spring (1982-). The Labour Party doubled its representation in the 1992 general election and in 1993 formed a coalition government with Fianna Fáil. Labour provided 6 of the 15 ministers and Spring took office as *tánaiste* (deputy prime minister).

Other countries that have a Labour (or Labor) Party include Australia, Barbados, Israel, Jamaica, the Netherlands, Norway, and the United States.

For information about the Australian Labor Party see **Australian Labor Party.** For information about other Labour parties see the articles on countries mentioned.

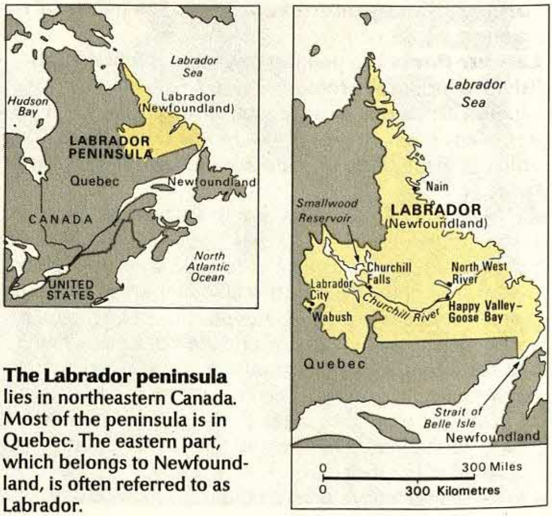
Related articles in ***World Book*** include:

Attlee, Clement Richard
Blair, Tony
Cabinet
Callaghan, Jim
Fabianism
Foot, Michael
Kinnock, Neil Gordon
Macdonald, James Ramsay
Parliament
Political parties
Smith, John
Socialism
Webb, Sidney and Beatrice
Wilson, Lord

Labour relations. See **Personnel management.**

Labrador is a large peninsula in northeastern Canada. It covers about 1,300,000 square kilometres between the Atlantic Ocean and Hudson Bay. The western part of Labrador belongs to Quebec. Labrador's so-called eastern "coast" forms part of Newfoundland. Since 1927, the term "coast" has meant the coast as well as an inland area extending as much as 724 kilometres west from the Atlantic. This article discusses the Newfoundland part of Labrador, which covers 294,330 square kilometres.

Labrador extends farther east than any other part of the North American mainland. The Strait of Belle Isle in the southeast separates Labrador from the island of



The Labrador peninsula lies in northeastern Canada. Most of the peninsula is in Quebec. The eastern part, which belongs to Newfoundland, is often referred to as Labrador.

Newfoundland. Quebec forms Newfoundland's southern and western boundaries in Labrador.

The abundance of fur-bearing animals and the rich coastal fisheries brought French settlers to Labrador in the early 1700's. Many people of Labrador still fish for a living. The fur industry is no longer of primary importance. Rich iron ore deposits in the west support a mining industry that began to develop in the 1950's.

Labrador is a land with long, severe winters. In the interior, snow covers the ground from September to June. The average July temperature ranges from 7° to 16° C. The climate makes agriculture difficult, except for some vegetable growing. The people depend on supplies brought from other parts of Canada for nearly all their food except fish and game meat. As part of Newfoundland, Labrador sends three representatives to the provincial legislature.

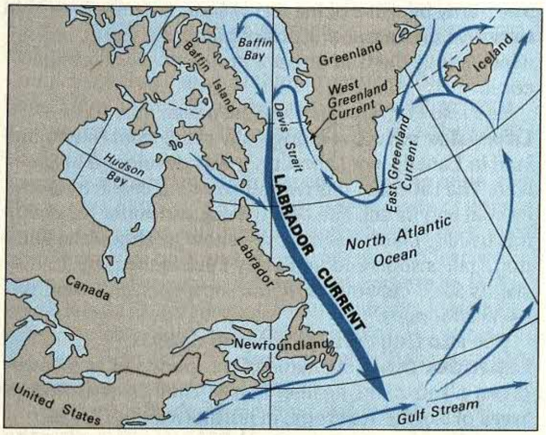
Labrador's population, based on the 1986 Canadian census, is 28,741. Most white settlers live in western mining communities, small fishing villages, and places such as Happy Valley-Goose Bay, which grew up around an air base established during World War II. Mining and fishing are the chief sources of income in Labrador. Eskimos and Indians make up about a tenth of the population.

Until the 1700's, only Eskimos and the Naskapi and Montagnais Indians of Algonquian origin lived in Labrador. The earliest white settlers were French fur traders and seal hunters.

The white settlers, Eskimos, and Indians were leading lives of extreme hardship when Wilfred T. Grenfell, an English medical missionary, first visited them in 1892. Grenfell made their suffering known and obtained money to build hospitals, schools, and church missions in Labrador.

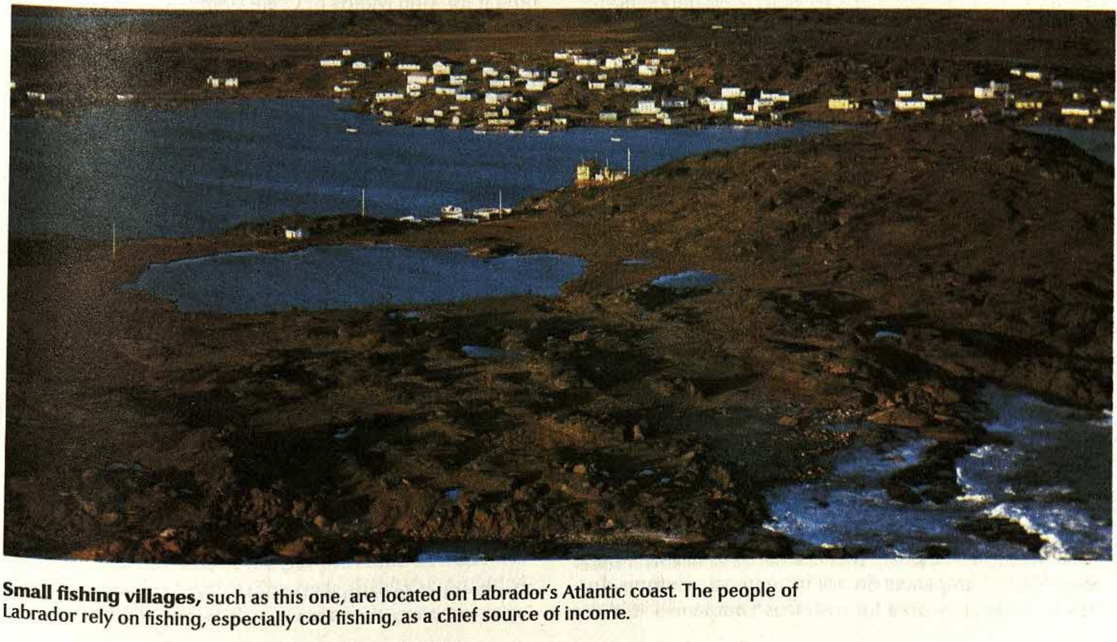
Newfoundland and Quebec disputed the ownership and boundaries of the Labrador interior as interest grew in the area's resources. In 1927, the British Privy Council finally settled this question by defining the present boundaries in favour of Newfoundland. It interpreted the term "coast" as "watershed." Thus, the Newfoundland part of Labrador includes the area drained by rivers flowing into the Atlantic Ocean along the east coast.

See also **Newfoundland.**



The Labrador Current flows along the eastern shore of Labrador and the island of Newfoundland. It is formed in the Davis Strait by converging cold currents.

Labrador Current is a cold ocean current that rises in the Arctic Ocean. It flows along the shores of Labrador, Canada, to a point near the island of Newfoundland, where it meets the Gulf Stream. The influence of the Labrador Current is felt as far south as New England in the United States. The harbours of Labrador are blocked with ice for about half the year, partly because of this cold current. But the ports of the British Isles, which have the same latitude as Labrador, remain open to shipping throughout the year. These ports are ice-



Small fishing villages, such as this one, are located on Labrador's Atlantic coast. The people of Labrador rely on fishing, especially cod fishing, as a chief source of income.

free partly because of the warm Gulf Stream. When cold air above the Labrador Current meets the warm, moist winds above the Gulf Stream, heavy fogs form off the coast.

See also **Fog; Ocean** (How the ocean moves).

Labrador retriever originally came from Newfoundland in Canada, not Labrador. It was developed in England. The Labrador has two outstanding characteristics, its coat and its tail. The coat is thick and water-resistant. It is usually black, but may be yellow or chocolate. The dog's tail is short and unusually thick at the base. It stands 55-57 centimetres at the shoulders, and weighs 24-36 kilograms.

See also **Dog** (picture: Sporting dogs).

Labrador tea is the name of six species of small evergreen plants of the heather family. They grow in wetland areas of Northern Europe, in northern and subarctic North America, and Greenland. The leaves have a mild narcotic substance and have been used for tea and as a substitute for hops in making beer. Tannin, used in tanning animal hides, also comes from the leaves.

Scientific classification. Labrador tea plants are members of the heath family, Ericaceae. They belong to the genus *Ledum.*

See also **Flower** (picture: Flowers of woodlands and forests).

La Brea pits are one of the world's richest known sources of Ice Age fossils. They lie in Hancock Park in Los Angeles. Beginning in 1906, when the remains of a giant prehistoric bear were found, about a million well-preserved skeletons of sabre-toothed tigers, giant wolves, llamas, camels, horses, giant ground sloths, and other ancient animals have been dug from the various layers of oil and tar. These animals became trapped when they came to drink from the shallow pool that covered the sticky asphalt bog.

La Bruyère, Jean de (1645-1696), was a French satirist. He is best known for *The Characters of Theophrastus, Translated from the Greek, with the Characters and Mores of This Age.* The book appeared in 1688 as an appendix to his translation of a work by Theophrastus, a Greek philosopher of the mid-300's to early 200's B.C. In each of the nine editions published during his lifetime, La Bruyère increased his own contribution so that the *Characters* stands as an original work. La Bruyère ridiculed the injustice and hypocrisy he saw in French life.

La Bruyère was born in Paris. He spent much of his life tutoring the children of noble families.

Labuan is an island in Brunei Bay off the coast of Sabah. It is administered as part of the Federal Territory of Malaysia along with Kuala Lumpur, the capital city of Malaysia (see **Malaysia, Government of**).

Labuan has an area of 96 square kilometres. It is generally low-lying, and its highest point is 97 metres. There are several small *kampongs* (villages) and a small town, Victoria. Coconut trees, *paddies* (rice fields), and rubber trees cover 30 per cent of the island. More than half of the island is under forest, scrub, or swamps.

The population of the island is 54,307. About three-quarters of the people belong to the *pribami* who were the original inhabitants of the island. A quarter of the people are Chinese.

Labuan is a *free port*—that is a harbour in a free-trade area where companies do not have to pay customs duties. It is a tax-free area for overseas companies. It is also an important centre for barter trade with the Philippines. A large fleet of supertankers uses its deepwater harbour to collect petroleum products.

Natural gas, produced in the coastal waters of Sabah, is processed into methanol on Labuan. It is also used as fuel for a 79-megawatt powerplant. A large industrial complex produces iron *briquettes* (small bricks).

Brunei ceded Labuan to Britain in 1846. The British intended to make Labuan into a naval base to protect its ships from pirates, but failed. Labuan became a colony for convicts, who worked in its coal mine in the late 1800's. The island joined the Malaysian Federal Territory in 1984. In 1990, the Malaysian government made the island a tax haven, hoping to develop a financial centre and attract multinational companies.

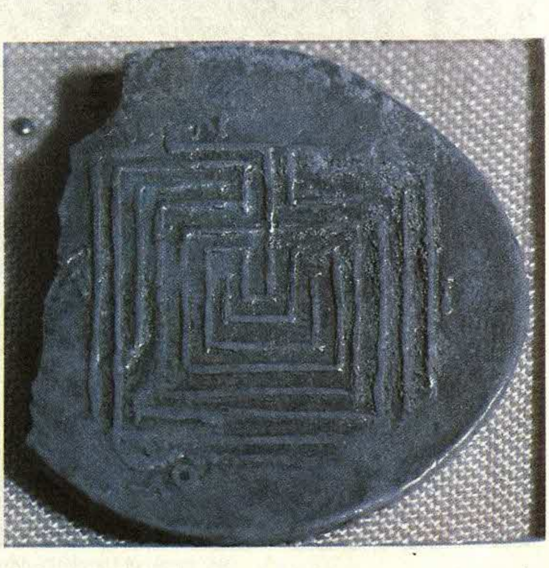
Laburnum is a small tree with bright yellow blossoms. Its leaves remain green until late in the autumn. The seeds grow in pods. The *common laburnum,* native to Asia, is sometimes called *golden chain* because of its long clusters of yellow flowers. It is also called *bean tree* and *bean trefoil.* This kind of laburnum is somewhat sensitive to cold. It has dull green, slightly hairy leaves. The Scotch laburnum is native to Central and Southern Europe. It is hardier than the common laburnum, and has longer flower clusters. The leaves are a glossy green. Old specimens of this tree have a gnarled appearance.

The seeds, roots, and other parts of laburnums contain a poisonous substance called cytisine. Laburnums should not be planted where there are young children. Laburnum wood is hard and dark. It is used as a substitute for ebony, for inlay work, and for making musical instruments. See **Ebony; Wood.**

Scientific classification. Laburnums belong to the pea family, Leguminosae (Fabaceae). The common laburnum is classified as *Laburnum anagyroides.*

Labyrinth, in anatomy. See **Ear** (The inner ear).

Labyrinth was a place with many confusing paths and passageways. According to Greek mythology, Daedalus built it for King Minos of Crete. Minos wanted it as a



The Cretan labyrinth is pictured on this ancient coin. According to mythology, the maze was built to imprison the Minotaur.

prison for the monster called the Minotaur. He sacrificed seven Athenian youths and seven maidens to the Minotaur every year.

Theseus, the son of an Athenian king, went into the Labyrinth, killed the Minotaur, and found his way out of the twisting passages. Ariadne, Minos' daughter, had given him a ball of thread to unwind as he went in. He followed the thread and escaped.

Archaeologists have discovered a palace that may have been the site of the Cretan Labyrinth. Located in the Cretan city of Knossos, it has many passageways and resembles the mythical Labyrinth. Many double axes were found at the palace. Most scholars believe that the word *labyrinth* came from *labrys,* which means *double axe.* Later, it came to mean any place that contained many confusing passageways. Archaeologists have also found traces of another great labyrinth in Egypt.

Buildings with confusing and seemingly endless networks of passages are found in some amusement parks. A modern labyrinth of this nature is sometimes called a *maze* and is used for testing skill in problem solving. Many toys and games are based on the idea of the labyrinth or maze. Psychologists use mazes in experiments to test the reactions of animals (see **Learning** [Multiple-response learning]).

Lac is a sticky substance given off by a kind of scale insect. The insects gather by the hundreds of thousands on the twigs and branches of the soapberry and acacia trees of India, Thailand, and Burma (see **Scale insects**). The sticky substance these insects secrete is called *lac.* The term comes from a Hindustani word meaning *hundred thousand.* Shellac is made from lac (see **Shellac**).

Lac insects pierce the bark of trees with their long beaks and feed on the sap. As they do so, they discharge a quantity of lac to protect themselves from their enemies. The female insect lays several hundred eggs before she dies. The young insects hatch as wormlike *larvae.* When the larvae grow into insects, they look for new, fresh twigs to feed on. This period in their life cycle is called *swarming.*

Lac is usually harvested by cutting almost all the twigs before the larvae mature. When the larvae are ready to swarm, the twigs are fastened onto trees where the workers want the insects to feed. The crude substance gathered from the twigs is called *stick lac.* Workers grind it between stones and wash it in water to remove the colouring matter. In this stage, the substance is called *seed lac.* Seed lac is processed either by hand, by machine, or through bleaching in hot sodium carbonate.

Shellac is made by dissolving processed lac in alcohol. Shellac is used in electric insulators and varnishes and to hold together pharmaceutical tablets and boiled sweets. Shellac is also used in printing ink and for hat stiffening.

Laccadive Islands are a group of tiny coral islands off the southwestern coast of India. They occupy about 18 square kilometres in the Arabian Sea and are part of the Union Territory of Lakshadweep, formerly known as Laccadive, Minicoy, and Amindivi Islands Territory. For location, see **India** (terrain map). The Union Territory covers about 32 square kilometres and has a population of about 51,600. Most of the people in the territory live on the Laccadive Islands. The rest inhabit the Amindivi Islands.

Most of the islanders speak the Malayalam language, but they belong to various Arabian tribes. The women make an elastic fibre called *coir* from coconut husks. Coir is used in the manufacture of matting. The men build boats and trade on the mainland. They exchange their copra and coconut fibre chiefly for rice, their principal food.

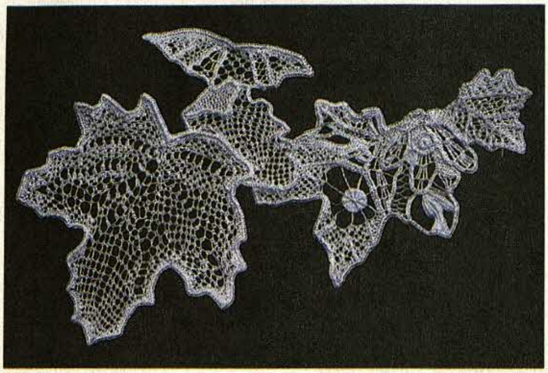
Lace is a decorative fabric that consists of an open, netlike pattern of threads. The finest lace is made of linen thread, but cotton, silk, wool, manufactured fibres, and even threads of gold and silver are also used. The design on most types of lace consists of patterns of flowers or leaves. Other designs feature animals, human figures, or such objects as columns and scrolls. Lace is used mainly to decorate clothing and to make ornamental items for homes and churches.

Most lace is made by machine, but the fabric was originally made by hand. Handmade lace is classified according to the way it is made. The two main types are *needlepoint lace* and *bobbin lace.* In making needlepoint lace, the lacemaker draws the design on parchment and sews it on a linen backing. Then he or she uses a needle and thread to fill in the pattern with embroidery stitches. For bobbin lace, the design is drawn on parchment attached to a pillow. To make the lace, the lacemaker uses many bobbins of thread. The thread is worked around small pins that are stuck into the pillow along the lines of the design.

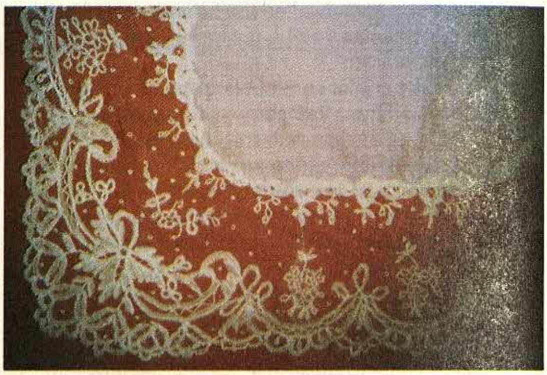
Lace can also be made in a number of other ways. For example, knotted threads are used in making a kind of lace called *tatting.* Techniques similar to those used in knitting are involved in creating *crochet lace. Tambour lace* is made by embroidering designs on netting. Lacemakers stitch pieces of muslin on netting to make *appliqué lace.*

Most handmade laces were named after the place where they were first made. One famous kind of needlepoint lace is Alençon, made in Alençon, France. Other outstanding needlepoint laces are Argentan, Brussels, and Venetian. Well-known bobbin laces include Chantilly, Mechlin, and Valenciennes.

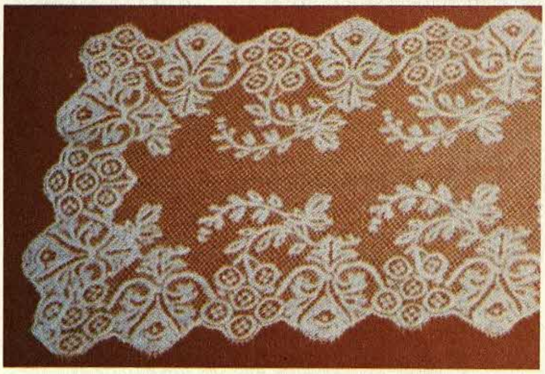
Lace is a decorative, netlike fabric that has many uses. This photograph shows dresses, Christmas tree ornaments, curtains, and a tablecloth—all made of lace.



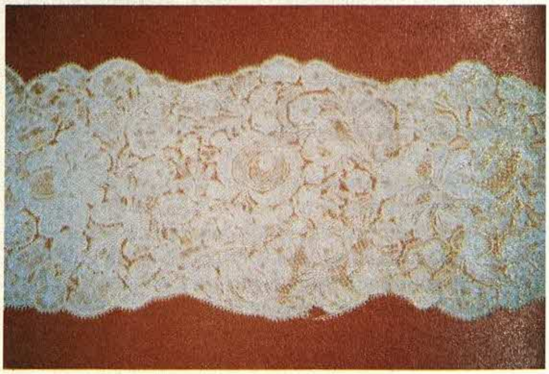
Venetian lace is one of the oldest types of needlepoint lace. This floral design was made in a style called *point de Venise.*



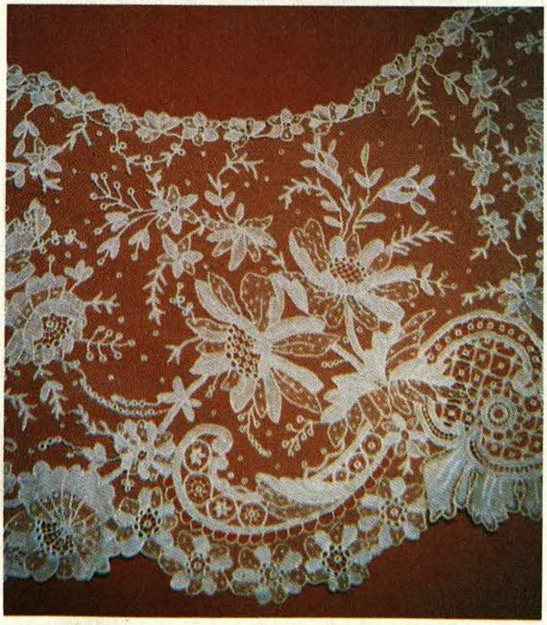
Appliqué lace is made by stitching pieces of muslin on netting. This appliqué lace was made in England.



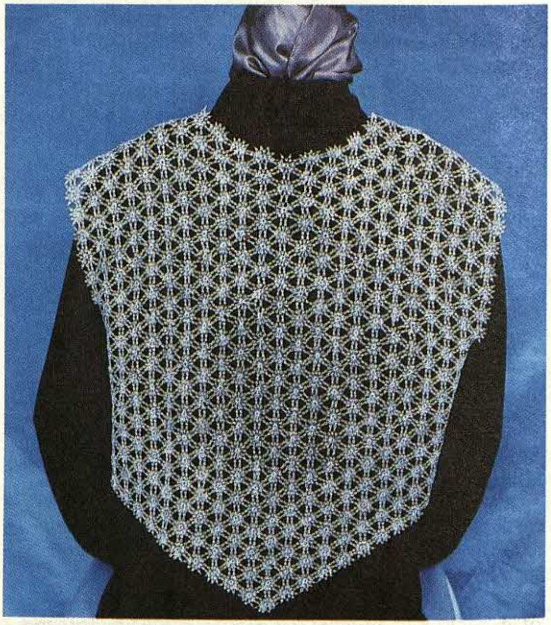
Valenciennes lace is a soft, delicate bobbin lace that was made in France and Flanders during the 1700's and 1800's.



Honiton lace is a type of bobbin lace named after the town in England where it was produced in the 1700's and 1800's.



Brussels lace called *point-de-gauze* is a fine, light needlepoint lace. Point-de-gauze was especially popular during the 1800's.



Tatting is lace made by looping and knotting cotton or linen threads with a shuttle.

Bobbin lace is made by hand in Italy, *above.* The lacemaker works bobbins around a design outlined by small pegs.

The art of lacemaking developed in Europe during the 1500's. Italy and Belgium were the chief centres of early lacemaking. During the early 1800's, British inventors developed the bobbin net machine. This machine became the basis for many of the machines used today in making lace.

See also **Crocheting.**

Lacedaemon. See **Sparta.**

La Ceiba (pop. 61,900), a chief Caribbean port of Honduras, lies 185 kilometres north of Tegucigalpa (see **Honduras** [map]). It is a distribution centre for the products of north and northeast Honduras. Industries in La Ceiba produce footwear, cigars, soap, and coconut oil. Exports from this port include abacá fibre, coconuts, and oranges.

Laceration. See **Bruise.**

Lacewing is an insect with thin and delicate wings. The two main kinds are green lacewings and brown lacewings. Some green lacewings have golden eyes, and some give off strong odours. Brown lacewings have brown eyes and wings.

The *larva* (young form) of the lacewing has large, sickle-shaped jaws. It captures and feeds on aphids, scales, and other insects, and even on the eggs of other lacewings. Some larvae, called *aphid lions,* are used by farmers to kill agricultural pests. The full-grown larva spins a silk cocoon. After two weeks, an adult lacewing emerges.

Scientific classification. Lacewings belong to the order Neuroptera. Common species belong to the brown lacewing family, Hemerobiidae, and the green lacewing family, Chrysopidae.

Lachesis. See **Fates.**

Lachlan is a river in New South Wales, Australia. It rises near Cullerin, in the Great Dividing Range, and flows into the Murrumbidgee River. It is almost 1,500 kilometres long, and its basin has an area of about 67,340 square kilometres. For location, see **New South Wales** (map).

Song dynasty (960-1279), China

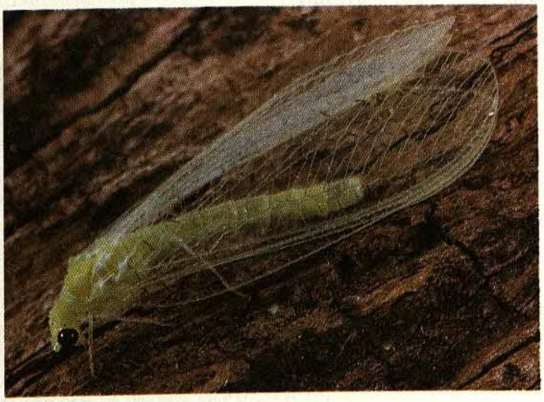
A Buddhist head was carved from hardened lacquer.

Lacquer is a shiny, protective film used on metals, woods, and porcelain. Lacquer is made from compounds of cellulose, resin, or lac.

Lacquer made with resin is called a true "spirit" varnish. The resin is usually mixed with turpentine. The turpentine evaporates when it is exposed to air, leaving only the coating of resin on the material. When a cellulose compound is used to make lacquer, the compound is usually dissolved in butyl alcohol or butyl acetate. The butyl compounds also evaporate when exposed to air. When lac is used to make lacquer, the evaporating solution used is ethyl alcohol. These lacquers are made in all colours that are commonly found in paints.

In the Orient, a natural lacquer is obtained from the sap of the lacquer, or varnish, tree. The Japanese and Chinese tap the tree and collect the sap. Then they strain the sap, and dry it by heat. This makes a dark-brown liquid as thick as syrup. The liquid is diluted and sometimes coloured before it is used as lacquer.

Modern lacquers are used to finish thousands of materials, including metals, paper, wood, and fabrics. The paper industry uses both clear and coloured lacquers to finish packages, labels, and book covers. In the furniture



The lacewing is a delicate insect named because of its two pairs of lacy wings. The insect has large golden-bronze eyes.

industry, lacquers are especially useful in retaining the colour of blond furniture. In addition, they give a waterproof finish to furniture. In the car industry, lacquers are used to give a high gloss to car finishes. Acrylic-resin lacquers make an excellent coating for polished metals such as brass and chromium.

See also **Cellulose; Lac; Resin; Varnish.**

Lacquerware is a decorative object made by coating an article, such as a box, dish, tray, or vase, with many layers of varnish. The varnish forms a durable, glossy, waterproof surface that can be painted, carved, or decorated in other ways. Two kinds of varnish can be used to make lacquerware, *lacquer* and *shellac.* These varnishes may be clear or coloured. Some objects have as many as 200 coats of varnish. Each coat is allowed to dry before the next one is applied.

The art of making lacquerware developed in China, where lacquer probably was first produced. Chinese lacquer objects date from as early as 300 B.C. The Japanese learned the art from the Chinese, probably during the A.D. 500's. In the early 1600's, China and Japan began exporting lacquerware boxes, chests, cups, screens, and other items to Europe. European artists soon began making lacquerware, but they used shellac instead of lacquer. During the 1700's, trade flourished in Europe for shellac-based European lacquerware. However, the finest lacquerware articles were still made in China and Japan.

See also **Lacquer; Shellac.**

Lacrimal gland. See **Tears.**

Lacrosse is a fast game adopted from the North American Indians. It is popular in Australia, Canada, England, and the United States. The object of lacrosse is to score a goal by throwing, scooping, or kicking a solid rubber ball into the opposing team's goal. Players move the ball with a stick that has a net pocket at one end. The word *lacrosse* comes from the French words *la crosse,* meaning *the crook.* The stick is formally called a *crosse.*

Men's lacrosse is played on a field 110 yards (101 metres) long and $53\frac{1}{3}$ to 60 yards (49 to 55 metres) wide. The net goals are centred between the sidelines with 15 yards (14 metres) of playing area behind each goal. The goals are 6 feet (1.8 metres) high and 6 feet wide. A circle with an 18-foot (5.5-metre) diameter, called the *goal crease,* surrounds each goal. The field is divided in half by the centre line.

A Chinese lacquerware plate with a carved dragon and flowers. It was made during the Ming dynasty (1368-1644).

A team consists of a goalkeeper, three defenders, three midfielders, and three attackers. Each player uses his stick to throw, catch, or carry the ball. Sticks have two parts, a handle and a head. Most handles are made of aluminium or wood. The head consists of a leather and string pocket attached to a plastic frame. Sticks range from 102 to 180 centimetres long, and the heads from 16.5 to 25.4 centimetres wide. Attacking players use shorter sticks with smaller heads than defensive players. The goalie's stick is 10 to 12 inches (25.4 to 30.5) centimetres wide. The ball is slightly smaller than a baseball. When thrown, it can travel up 160 kilometres per hour. Players wear shorts, cleated shoes, plastic helmets, arm pads, and padded gloves.

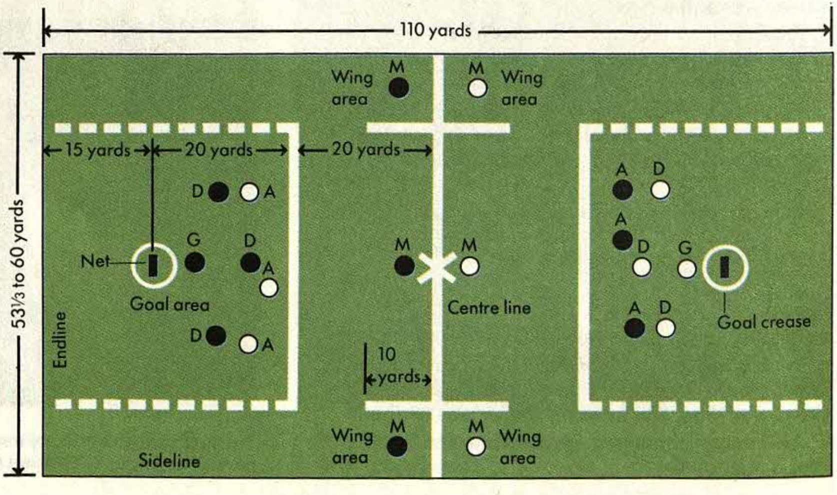
A game consists of four 15-minute quarters. A *face-off* in the centre of the field starts play each quarter, and

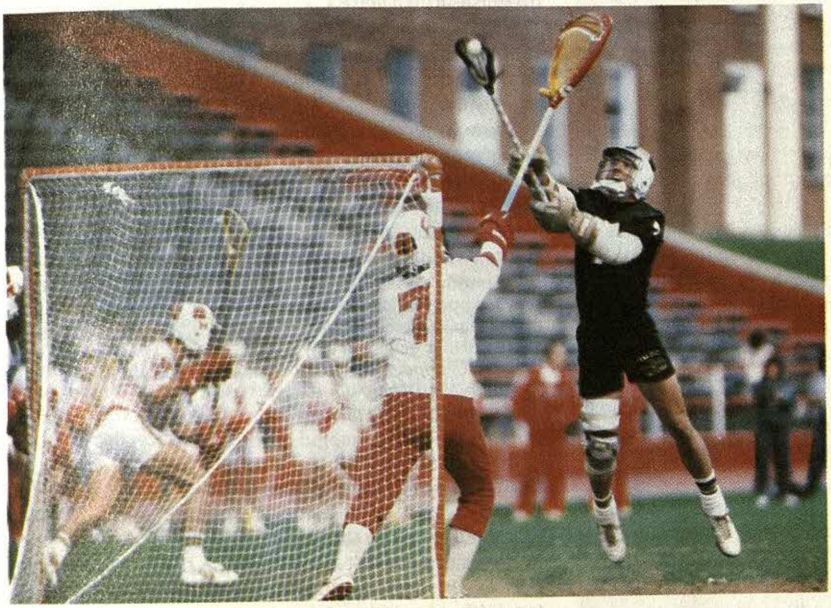
Lacrosse field diagram and players' positions

This diagram shows a men's lacrosse field and the positions players take at the start of a game. The game begins with a face-off between two midfielders at the cross mark in the centre of the field. Women's games are played with 12 players on each side instead of 10. The women's field has no official boundaries but is usually longer and wider than a men's field.

Key to positions

D=Defence
A=Attack
M=Midfield
G=Goal





Lacrosse is a fast team sport. Players use a stick with a net pocket at one end to move the ball down the field. A team scores by putting the ball into the opponent's goal.

after a goal is scored. In a face-off, two midfielders crouch down with their sticks on the ground. The referee places the ball between the two sticks, and the players try to gain possession of it at the referee's signal. The other midfielders can move when play begins, but the defenders, attackers, and goalkeepers must remain in their own areas until possession is indicated by the referee. The ball is carried in the stick and passed or kicked by the players in order to get it in the opponent's goal.

Each team must always have at least three players on the offensive end of the field and four on the defensive end. Violation of this rule is called *offsides.* The only players who may touch or bat the ball with their hands are the goalkeepers. A referee, an umpire, and a field judge serve as officials.

Opposing players may *check* (block) each other with the stick or the body. Body checking above the knees and from the front is legal. Illegal body checks are *personal fouls,* requiring the player to leave the game for 1 to 3 minutes, depending on how serious the official considers the foul. In most cases, players must leave for 30 seconds for such *technical fouls* as offsides. A team must play shorthanded during this time.

Women's lacrosse is usually played on a field 120 yards (110 metres) long and 70 yards (64 metres) wide. But rules do not list specific field dimensions. A team consists of 12 players. The game is 50 minutes long, divided into 25-minute halves with a 10-minute intermission between halves. Body contact is not allowed in women's lacrosse.

History. Lacrosse developed from a game played by Canadian Indians. The Indian game was a rough, often brutal sport, with as many as a thousand warriors taking part. Canadians adopted the Indian game, forming the Montreal Lacrosse Club in 1856.

Lactation is the giving of milk by mammals. Soon after a female mammal gives birth to young, milk begins to form in her mammary glands (see **Mammary glands**). Certain chemicals called *hormones* stimulate cells in the mammary glands to produce milk. Young mammals feed on milk until they are able to get food by themselves. Milk contains substances necessary for growth, such as carbohydrates, fats, and proteins. When the young stop feeding on milk, the mammary glands stop milk production.

The lactation period varies in different *species* (kinds) of mammals. For example, the lactation period lasts about 10 months in cows, and about 2 years in walruses. When the mammal becomes pregnant again, the lactation period begins once more.

See also **Mammal.**

Lactic acid is the common organic acid found in milk and other dairy foods that have turned "sour." It also occurs in sauerkraut, pickles, and beer. It exists in two forms, *D-lactic acid* and *L-lactic acid.* D-lactic acid is formed by the fermentation of sugar. L-lactic acid is found in human and animal blood. During bursts of muscular activity, L-lactic acid builds up in the muscle tissue, causing soreness and fatigue. It slowly disappears as the muscles recover.

Lactic acid is formed naturally by the fermentation of *lactose* (milk sugar). Its name comes from the Latin word *lac,* which means *milk.* Carl Scheele, a Swedish chemist, first isolated the acid from sour milk in 1780.

Commercially, the acid is prepared by fermentation of cornflour, molasses, potatoes, or *whey* (the watery part of milk). It is widely used in foods and beverages to bring out flavour. The tanning industry uses crude lactic acid to remove lime from hides. The textile industry uses it in dyeing wool. It combines with alcohols to form *lactate esters,* used as lacquer solvents and in medicines and foods.

Lactic acid is a colourless or yellowish syrupy liquid that mixes readily with water. Its chemical formula is $C_2H_4(OH)COOH$. It has several forms that differ only in the arrangement of the atoms.

See also **Acid; Scheele, Carl Wilhelm.**

Lactose. See Carbohydrate.

Ladies Professional Golf Association. See Golf (Tournaments; Women's golf).

Lading, Bill of. See Bill of lading.

Ladoga, Lake. See Lake Ladoga.

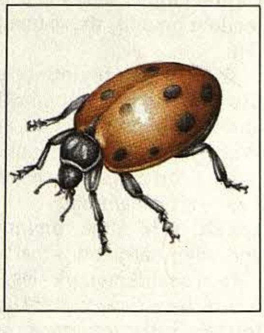
Lady in the United Kingdom is a member of the nobility or the wife of a nobleman. A woman who holds a title in her own right, including *marchioness, countess, viscountess,* or *baroness,* ranks as a lady. The daughter of a duke, marquess, or earl is also called a lady. The wife of a knight or baronet carries the title *lady,* but loses it if her husband dies and she marries a commoner. A lady of the royal household is a *lady in waiting,* and a lord mayor's wife is a *lady mayoress.* The first ladies gained seats in the House of Lords in 1958. See also **Nobility** (Privileges of the peerage).

Lady Day is the traditional name of the Christian feast of the Annunciation of the Blessed Virgin. Lady Day is one of the four *quarter days,* and falls on March 25 (see **Quarter days**).

In the Middle Ages, and until 1751, the civil and legal year began on Lady Day. The fiscal year now begins on April 6, which is the equivalent of Lady Day in the old calendar (see **Calendar**).

Lady Godiva. See **Godiva, Lady.**

Ladybird is a small beetle with a round body shaped like half a pea. It is often bright red or yellow, with black, red, white, or yellow spots. Ladybirds feed chiefly on aphids and scale insects. For this reason, fruitgrowers find ladybirds helpful. In the late 1800's, the *cottony cushion scale,* a scale insect pest, almost destroyed the fruit crop of California in the United States, and ladybirds were brought in to control the pest and save the crop. There are a few species of ladybirds that harm beans, melons, and other garden plants. But the work of the beneficial ladybirds far outweighs the damage done by harmful ones.



Ladybird

Scientific classification. Ladybirds are in the order Coleoptera and make up the family Coccinellidae.

See also **Aphid; Beetle** (picture); **Insect.**

Lady's finger. See **Okra.**

Lady's-slipper is any one of several showy wild flowers of the orchid family. The plants grow in moist woodlands of many parts of Europe, Asia, and North America. One of the petals of the flower is enlarged, forming a lip called a *labellum.* It is this structure that makes the flower resemble a slipper. In some parts of North America, the lady's-slipper is also known as the moccasin flower.

The *showy lady's-slipper,* or *pink and white lady's-slipper,* has large white flowers, but its lip is tinged with brilliant pinkish purple. The *yellow lady's-slipper* has beautiful, waxy, yellow flowers. Its petals twist in a spiral. The *pink lady's-slipper* is the provincial flower of the Canadian province Prince Edward Island. The blossoms have a velvety pink or white lip with reddish veins and greenish-brown sepals. The *small white lady's-slipper* grows in such damp places as bogs and marshy meadows.

Some tropical orchids with slipper-shaped petals are also called lady's-slippers. They grow in North and South America and in Asia.

Scientific classification. Lady's-slippers belong to the orchid family, Orchidaceae. There are four genera of lady's-slippers: *Cypripedium, Paphiopedilum, Phragmipedium,* and *Selenipedium.*

Lady's-slipper

See also **Orchid.**

Lae (pop. 61,617) is the administrative centre of Morobe district of Papua New Guinea. It lies at the mouth of the Markham River, on the Huon Gulf, which is on the northeastern coast. It is the country's major shipping port. Lae is a major industrial centre, supplying the territory with many industrial and commercial products.

Before the establishment of the Lae airstrip in 1928, aircraft operations to the goldfields of Edie Creek and Bulolo were based at Salamaua. Lae developed due to the need for better airstrip facilities to carry heavy equipment to the Highlands. It was captured by the Japanese in March 1942, and recaptured in a battle in September 1943. During this battle, Lae was completely destroyed. The town was rebuilt in 1945.

Laënnec, René Théophile Hyacinthe (1781-1826), a French doctor and surgeon, invented the stethoscope in 1816. Doctors use this instrument to listen to the sounds of the heart and other organs. Laënnec investigated diseases of the heart and the lungs, and published his conclusions in *A Treatise on Mediate Auscultation* in 1819. He was rarely in good health and died from tuberculosis, a disease on which he had become an expert. Laënnec was born in Quimper, France. See also **Stethoscope.**

Laetrile is a controversial drug used to treat cancer. Most cancer specialists oppose the use of laetrile because it has not been proved effective as a cancer treatment. But supporters of laetrile claim that it has halted or even cured cancer in many patients.

Laetrile is extracted from apricot pits. Certain enzymes in many foods break down laetrile. During this process, a poisonous substance called *cyanide* is released. Many supporters of laetrile claim that the enzymes are also present in cancer cells. They believe that after laetrile is injected into the bloodstream of a patient, cyanide is released in the cancer cells and kills them. According to this theory, healthy body cells are not affected because they do not contain the enzymes that break down laetrile.

Laetrile is usually administered by injecting it into the bloodstream. However, some cancer victims take laetrile pills, which are broken down in the stomach by certain enzymes contained in many foods. Cyanide poisoning, which can be fatal, may result.

In the United States, 18 states have legalized the manufacture, sale, and use of laetrile. But the U.S. Food and Drug Administration (FDA) has banned the transportation of laetrile—and of substances used to make it—across state borders.

Some people favour legalization of laetrile. They insist that cancer patients have the right to choose any form of treatment that they may desire. Opponents argue that if laetrile were available, many cancer victims would choose it mainly because it has fewer side effects than other forms of therapy. As a result, the patients who chose laetrile would lose any chance of being helped by traditional forms of treatment.

In an effort to settle the controversy over laetrile's effectiveness, the National Cancer Institute in the United States began a study of the drug in 1980. The results from this study, released in 1981, showed that laetrile had been ineffective in treating cancer in human patients and that the drug could be dangerous.

La Farge, John (1835-1910), was an American painter. In the 1860's, La Farge painted many landscapes and still lifes of flowers that reveal a sensitivity to delicate shadings of light and atmosphere. During the 1880's and 1890's, he painted a number of murals in a style derived from Italian Renaissance art. La Farge visited Japan in 1886 and Polynesia in 1890 and 1891. These trips inspired a series of fresh, bright water colours. La Farge made an important contribution to stained-glass design by inventing new techniques for producing colours of remarkable brilliance. He designed richly coloured stained-glass windows for the mansions of wealthy clients and for churches.

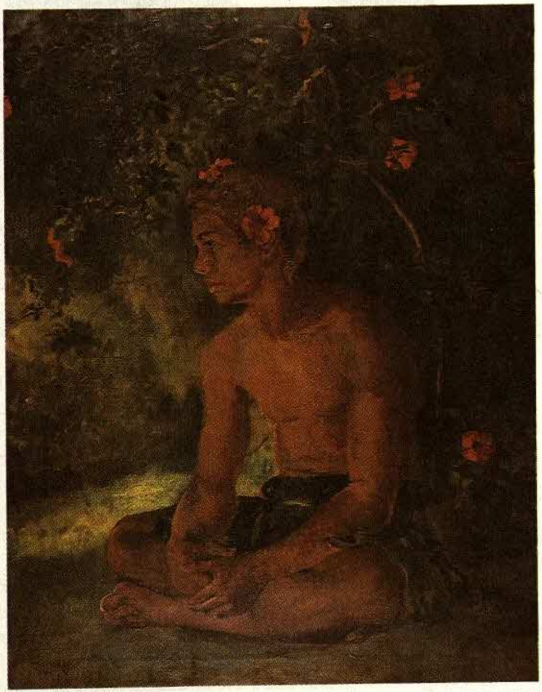
La Farge was born in New York City. He travelled widely and was part of an intellectual circle that included the writers Henry Adams and Henry James. La Farge also lectured and wrote on art theory.

La Farge, Oliver (1901-1963), was an American author and anthropologist. La Farge was best known for his novels and short stories about Indian life in the American Southwest and in Central America. He also wrote studies of Indian ceremonies, customs, and languages. La Farge became a leading spokesman for the rights of Indians in the United States.

La Farge received the 1930 Pulitzer Prize for fiction for his first novel, *Laughing Boy* (1929). The book describes a Navajo Indian's problems adapting to white society. La Farge's other fiction about Indians includes the novels *Sparks Fly Upward* (1931), *The Enemy Gods* (1937), and the stories collected in *All the Young Men* (1935). One of his major anthropological works is *Tribes and Temples* (1927), written with the American anthropologist Frans Blom. The book describes the Maya Indian language.

Oliver Hazard Perry La Farge was born in New York City. During the 1920's, he made several archaeological expeditions to Arizona, Mexico, and Guatemala to study Indian culture. La Farge was also active in a number of organizations devoted to improving the life of American Indians. La Farge settled in Santa Fe, New Mexico, U.S.A., about 1940.

La Fayette, Madame de (1634-1693), was a French novelist. *The Princess of Cleves* (1678), her masterpiece, has been called the first French psychological novel. The book is noted for its sober style and simple structure. Set in the 1500's, it is the story of a princess who is secretly in love with the Duke of Nemours, a dashing nobleman at the court of Henry II. The princess confides her secret to her adoring husband, who dies of a broken heart. She refuses to marry Nemours because she believes he is incapable of remaining faithful to her. In addition, she feels guilty about indirectly causing her husband's death, and she values emotional tranquility. Madame de La Fayette also wrote two other works, *The Princess of Montpensier* (1662), a novelette; and *Zayde* (1670), a rambling romantic tale.



Maua, Our Boatman, an oil painting on canvas

A John La Farge portrait of a Tahitian man was painted in 1891, while the artist was visiting Polynesia. La Farge was one of the first American artists to travel to the Pacific Islands. He painted many pictures of the scenery and people he saw there.

Madame de La Fayette was born Marie Madeleine Pioche de La Vergne in Paris, and married François, Comte de La Fayette.

Lafayette, Marquis de (1757-1834), was a French soldier and statesman. He fought for American independence and was a prominent leader in the early stages of the French Revolution.

Lafayette was born at Chavaniac, in Haute Loire, on Sept. 6, 1757. He welcomed the American Revolution as an opportunity to win military glory by fighting against Great Britain for France. He purchased a ship and landed in America in 1777 with a party of soldier-adventurers.

In early 1779, a few months after France declared war on Britain, Lafayette returned home as a hero. He hoped to join an invasion of Britain, but it never took place.

In April 1780, Lafayette returned to his post as major general in the American Army. In 1781, Lafayette led a small American force in Virginia that cooperated with the French fleet and Washington in forcing a larger British army under General Charles Cornwallis to surrender at Yorktown.

Detail of an oil painting on canvas (1799) by Charles Wilson Peale; Lee Collection, Washington and Lee University, Virginia, U.S.A.

Marquis de Lafayette helped the colonists in the American Revolution. He persuaded France to send military aid, and assisted in the negotiations that won American independence.

Lafayette had become a "hero to two worlds" when he returned to France in 1782. He became absorbed in the questions of free trade, tax reform, emancipation of slaves, and religious freedom for Protestants. In the events leading to the French Revolution in 1789, he did not hesitate to sacrifice court favour and position in behalf of his liberal ideas.

As commander of the new National Guard, Lafayette was one of the most powerful men in France from 1789 to 1791. But he did not believe in seizing political power for himself. He was unwilling to work with the corrupt but able Comte de Mirabeau. Queen Marie Antoinette and her court resented Lafayette. She said: "It would be better to perish than be saved by M. de Lafayette." As radicalism spread, Lafayette found it necessary to suppress crowd violence. By the summer of 1791, his popularity had gone. He found himself hated by the people, the former nobles, and the court.

After the Constitution of 1791 went into effect, Lafayette temporarily retired from active politics. When war against Britain broke out in 1792, he took charge of troops in what is now Belgium. As the military front collapsed, he unsuccessfully tried to suppress the rising tide of Jacobin radicalism at home (see **Jacobins**). Lafayette, denounced as a traitor, fled abroad. The Austrians imprisoned Lafayette in 1792 until Napoleon's victories won his release in 1797.

Under Napoleon, Lafayette was elected to the Chamber of Deputies. As one of the vice presidents of the chamber, Lafayette worked for Napoleon's second abdication after the Battle of Waterloo.

Except for the reactionary periods of 1815 to 1817 and 1824 to 1827, Lafayette continued to serve in the Chamber of Deputies. He became a focal point of liberal resistance to the Bourbon kings. He upheld American interests, and fought for the cause of independence and reform in Greece, Spain, Portugal, Italy, Poland, and the South American republics.

Once more, in 1830, Lafayette became the leader of a revolution that dethroned the Bourbons. Again in command of the National Guard, he refused popular demand that he become president of the new republic. Instead, he helped make Louis Philippe the constitutional monarch of France. But Lafayette came to regret this decision and, before his death in 1834, he began to hope for a pure republic in France.

Laffite, Jean (1780?-1826?), also spelled *Lafitte,* was an American smuggler, pirate, and patriot based around New Orleans. In 1810, he became chief of a band of outlaws with headquarters on Grande Terre Island in Barataria Bay in the Gulf of Mexico. With his brother Pierre, he commanded a fleet of ships and raided both Spanish and neutral vessels in the Gulf. His ships flew the flags of the Central and South American nations revolting against Spain.

In 1813, Governor William Claiborne of Louisiana offered 500 U.S. dollars for Laffite's capture. Laffite, then at the height of his power, boldly offered 1,500 U.S. dollars for the governor's head. All efforts to take and prosecute Laffite under the law failed.

In 1814, the British were at war with the United States. They offered Laffite 30,000 U.S. dollars, a pardon, and a naval captaincy if he would aid them in attacking New Orleans. He refused, informed the United States government of the plans, and offered the services of the Barataria smugglers to the United States. Laffite fought for General Andrew Jackson in the Battle of New Orleans on Jan. 8, 1815, and received a pardon from President James Madison.

American forces had destroyed the community at Barataria, so Laffite moved to Galveston Island. There, he established a town called Campeachy, and returned to piracy. He made himself "governor" of the island. After he raided the Louisiana coast and scuttled an American ship, the United States sent an expedition in 1821 to destroy the Galveston pirate colony. Laffite, who in spite of his swagger could be a gallant gentleman, quietly yielded, set fire to his town, and sailed away. Most historians believe that he died either in exile in Yucatán or in battle. Jean Laffite was born in France.

La Fontaine, Jean de (1621-1695), a French poet, is famous for his *Fables* (1668-1694). Modelled on *Aesop's Fables,* La Fontaine's fables portray human behaviour through animal characters. But La Fontaine suggests more forcefully than Aesop that life is a jungle. La Fontaine treated such serious subjects as power, greed, and violence with an amused, philosophical acceptance. He wrote his fables in light, natural verse. Despite their pessimism and sophistication, the *Fables* still play a large role in the education of French children. La Fontaine also wrote a collection of racy stories called *Contes (Tales)* (1664-1666).

La Fontaine was born in Château-Thierry. His friends described him as childlike, absent-minded, and ill-at-ease in society. A series of wealthy, cultured patrons supported him.

Lag ba'omer is a minor Jewish festival that falls on the 18th day of the Hebrew month of Iyar (approximately May). It is the 33rd day of the *omer,* the 49 days that separate the festivals of Passover and Shavuot. Unlike most Jewish holidays, which have Biblical bases, Lag ba'omer has been observed for only about 1,000 years. Lag ba'omer is also called the *Scholars Festival* because it commemorates the end of a violent epidemic that raged among the students of Rabbi Akiva ben Joseph in Palestine during the early A.D. 100's.

Lagan. See Flotsam, jetsam, and lagan.

Lagan is a river in Northern Ireland. It rises on the slopes of Slieve Croob, in Down, and flows northwestward through the town of Dromore, before turning gradually northeastward towards Lisburn. The river then continues to Belfast where it enters Belfast Lough.

Lagerkvist, Pär Fabian (1891-1974), a Swedish novelist, playwright, and poet, won the Nobel Prize for literature in 1951. He is known for such plays as *The Hangman* (1933), *Midsummer Night in the Workhouse* (1941), and *Let Man Live* (1949), and such novels as *The Dwarf* (1944), *Barabbas* (1951), and *Pilgrim at Sea* (1964). His lyrical poetry has deep philosophical content. He wrote about the cruelty of his time, and urged people to show more humanity and tolerance. He was born in Växjö, Sweden.

Selma Lagerlöf

Lagerlöf, Selma (1858-1940), a Swedish writer, won the 1909 Nobel Prize for literature. She is best remembered for the meaning and depth she gave to materials of folk origin. *Gösta Berling's Saga* (1891), her first novel, is her most admired book. It is a fantastic romance in loosely related episodes that deal with a swashbuckling defrocked minister and his fellow adventurers. Like much of Lagerlöf 's fiction, the book is set in Värmland, the province in west-central Sweden where Lagerlöf was born.

Religion plays an important part in Lagerlöf 's writing. In her two-volume novel *Jerusalem* (1901-1902), she tells the story of a Swedish religious group awaiting the second coming of Christ. In *Christ Legends* (1904), she elaborates on Christian mythology.

The Wonderful Adventures of Nils (1906-1907) is a geography textbook in fairy tale form. It describes Sweden through the eyes of a boy travelling over the country on the back of a wild goose. The book is both factually sound and full of charm. Lagerlöf also used fairy tale elements in *Liljecrona's Home* (1911), a story based on her own family in the early 1800's. The trilogy *The Ring of the Löwenskölds* (1925-1928) combines mystery, romance, and family history. It includes *The General's Ring, Charlotte Löwensköld,* and *Anna Svärd.*

Selma Ottiliana Lovisa Lagerlöf was born in Mårbacka, her simple family home in Värmland. She was a teacher from 1885 to 1895.

Lagoon is a shallow body of water separated from the open sea. The land that separates a lagoon from the sea may be a coral reef, a sandy ridge called a *spit,* or a narrow expanse of sand called a *barrier island.* Lagoons formed by barrier islands are found along the east coast of the United States and along the Gulf of Mexico.

Sand and other sediments carried in by ocean tides build up in a lagoon because it is protected from the pounding action of waves. These deposits eventually fill in the lagoon and connect the two stretches of land that it separates.

See also **Atoll.**

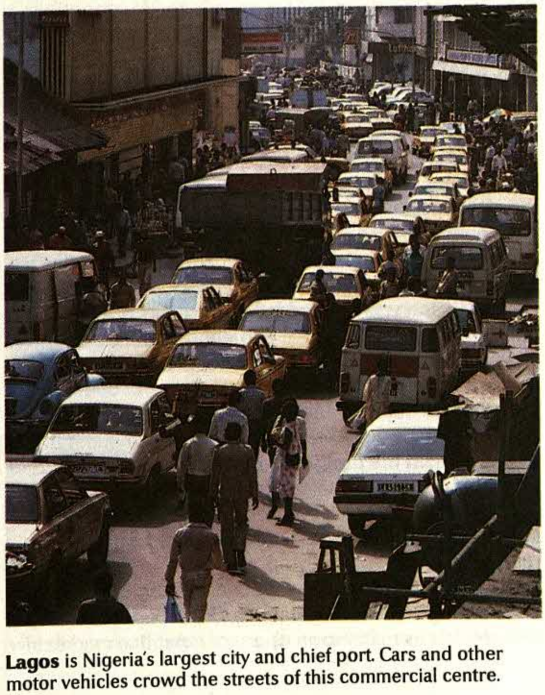
Lagos (pop. 1,149,200) is the largest city of Nigeria. Lagos lies partly on the African mainland and partly on four islands in the Gulf of Guinea.

Lagos is Nigeria's chief port and commercial centre. The city's harbour handles about 1.8 million metric tons of cargo yearly. Lagos serves as the chief outlet for Nigeria's animal hides and skins, cacao, palm tree products, peanuts, and timber. The city's air, railway, road, and water transportation facilities provide links with other parts of Nigeria. An international airport operates at nearby Ikeja.

Lagos is Nigeria's main manufacturing city. Its industries include the assembly of motor vehicles and radios, brewing, food processing, oil storage, steel processing, and the production of textiles, soap, and candles.

Yoruba people lived in what is now Lagos before Portuguese explorers arrived in the late 1400's. Lagos was a major slave market until 1851, when it became a British protectorate. The British government annexed Lagos in 1861 and made it the capital of Nigeria in 1914.

In 1980, the Nigerian government began building a new city called Abuja near the centre of the country to replace Lagos as the capital. In December 1991, Abuja became Nigeria's official capital. But construction had not been completed, and government activities were carried out in both cities.


Lagos is Nigeria's largest city and chief port. Cars and other motor vehicles crowd the streets of this commercial centre.

Lagrange, Joseph Louis (1736-1813), was a French mathematician. His most famous work, *Analytical Mechanics* (1788), is an algebraic study of the forces and motion involved in orbits of planets, the flow of liquids, and vibrating strings. Lagrange also wrote on interpolation, probability, and number theory, and helped set up the French metric system. Lagrange was born in Turin, Italy. At the age of 16, he became a professor of mathematics in the royal artillery school in Turin.

See also **Number theory.**

La Guardia, Fiorello Henry (1882-1947), gained national fame as the mayor of New York City from 1934 to 1945. A liberal Republican, La Guardia became known as a progressive reformer who was sensitive to the needs of ordinary citizens. As mayor, he cooperated with Democratic President Franklin D. Roosevelt's economic recovery programme, known as the *New Deal.* La Guardia's urban reforms included slum clearance; school, park, and street development.

La Guardia was born in New York City. He graduated from the New York University Law School in 1910. La Guardia served in the United States House of Representatives from 1917 to 1921 and 1923 to 1932. In Congress, he co-sponsored the Norris-La Guardia Act of 1932, which protected the rights of striking workers.

Fiorello La Guardia

Lahore (pop. 2,952,689) is the second largest city in Pakistan. Only Karachi has more people. Lahore is the capital of Punjab, a province in northeast Pakistan (see **Pakistan** [political map]). The city is a centre of weaving, milling, and other industries. Lahore is also an educational centre. It has a museum and several schools, including Punjab University.

The oldest part of Lahore is at least a thousand years old. It has many landmarks that recall the glories of the Mughal period in India's history. Lahore was the capital of the Sikh Empire before the British took it over, and the city has many historic Sikh shrines. Many houses have balconies and lattice windows decorated with carved woodwork. Lahore has a magnificent Muslim mosque, a mausoleum, and a royal palace. In 1947, the Punjab region was divided into two sections, and Lahore's position as a cultural and political centre declined. The city's economy also declined in this period, and its recovery since has been slow.

Laird is the Scottish equivalent of the English word *lord.* A laird is a landowner in Scotland, and generally has tenants. In the past, a laird's tenants paid food and service in return for the use of land. In the Highlands, until the late 1700's, a laird's tenants may have been members of his clan who owed him military service in return for land.

Laissez faire is a theory of economic policy which states that government generally should not interfere with decisions made in an open, competitive market. These decisions include setting prices and wages and making other choices that affect the sale of goods and services. According to laissez faire, workers are most productive and a nation's economy functions most efficiently when people can pursue their private economic interest in relative freedom.

Laissez faire is a French phrase meaning *allow to do.* It was first made popular by a group of French writers called *physiocrats* between the 1750's and 1780's. At that time, the governments of many European countries practised a set of policies known as *mercantilism.* Mercantilism involved strict regulation of agriculture, industry, and trade. Its chief goal was to ensure that exports exceeded imports. The physiocrats insisted that the imposition of such restrictions actually hindered the growth of trade.

A group of thinkers called the *British classical school,* led by the Scottish economist Adam Smith, gave the laissez-faire principle its fullest explanation and defence between the 1770's and the 1840's. Their support came at a time when laissez faire suited the needs of a rapidly developing industrial economy. The classical economists started from the assumption that individuals are motivated by self-interest. They maintained that people serve their own interests best when they provide the goods and services most wanted by others. Individuals who operate in an open, competitive market automatically promote prosperity for all. Thus, the government should have little to do with regulating the economy.

The theory of laissez faire greatly influenced economic thought and action during the early and mid-1800's. Later, however, critics charged that laissez faire failed to solve many economic and social problems that had arisen. Gradually, the governments of industrial nations started to regulate economic activities more closely. They also passed laws aimed at relieving major social problems such as poverty and unemployment.

Some modern economists call for a return to laissez-faire policies. The American economist Milton Friedman ranks as one of the leading supporters of such policies.

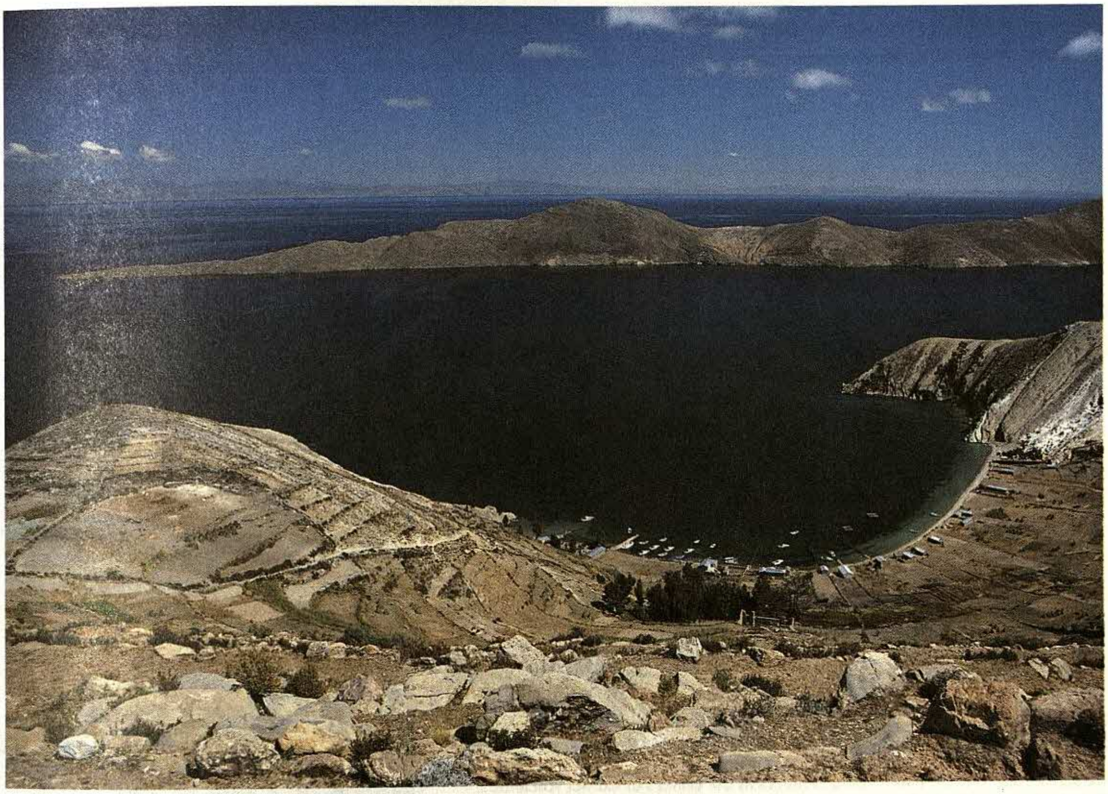
See also **Capitalism; Economics** (Capitalism; Early theories); **Freedom** (Economic freedom); **Physiocrats; Smith, Adam.**

Lake is a colouring substance that will not wash out. It is formed by combining *mordants* with dyestuffs. Mordants are usually metallic salts which change to metallic hydroxides. These react chemically with soluble dyes to form the insoluble, coloured lakes.

There are two kinds of lakes. One is produced from natural dyes. The other is made from coal tar dyes. Natural lakes include carmine, madder, and the Vienna dyes fixed with aluminium or tin. Carmine lake is prepared from the colouring matter of cochineal insects. Carmine lake is a beautiful scarlet colour. Madder lake is red. It comes from the root of the madder plant. Vienna lake is a violet colour and comes from brazilwood.

Coal tar dyes can give a much wider range of colour. These dyes are produced at a much lower cost. They have almost entirely replaced the natural lakes. Lakes are used in calico-printing, silk-dyeing, for decorative work, colour-printing, and also as colour pigments in paints and lacquers.

See also **Mordant.**



Different kinds of lakes include glacial lakes, volcanic lakes, and artificial lakes. Lake Titicaca was formed by glaciers in the mountains that lie on the border between Peru and Bolivia. Isla del Sol, *above,* is one of the lake's many islands. Titicaca is the world's highest navigable lake.

Lake is a body of water surrounded by land. Lakes may be found in all parts of the world. Some large bodies of water commonly known as seas are really lakes. These include the Dead Sea, the Sea of Galilee, and the Caspian Sea. Some lakes lie near the highest regions of the earth, and others are far below sea level. Lake Titicaca, in South America, is 3,812 metres above sea level. The Dead Sea, between Israel and Jordan, lies about 399 metres below sea level. Lake Eyre, Australia's largest lake, reaches 16 metres below sea level. It fills only when infrequent rainstorms occur. The word *lake* comes from the Greek word *lakkos,* meaning *hole* or *pond.*

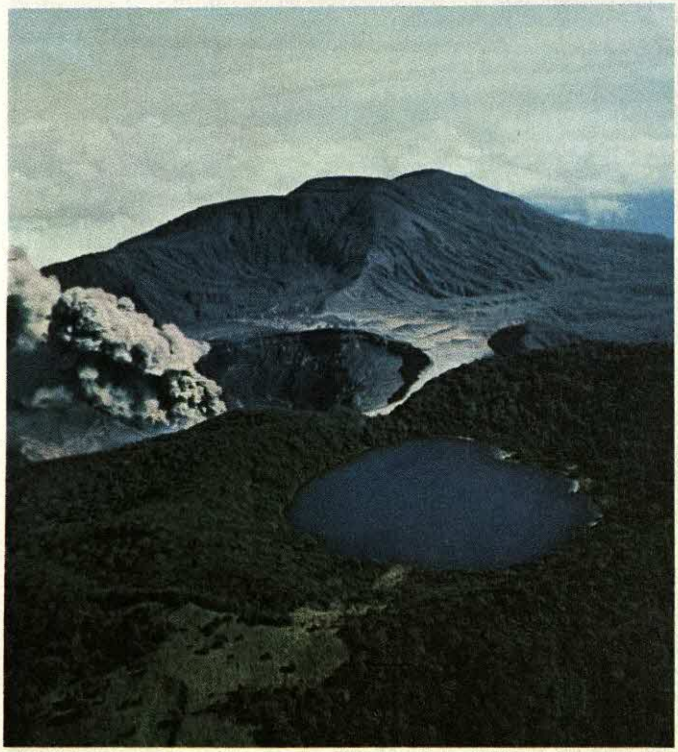
The life of a lake

How lakes are formed. The greatest number of lakes lie in regions that were once covered by glaciers. Glaciers cut deep valleys as they travel, and glacial deposits act as a dam. When a glacier begins to melt, its waters often collect in these valleys to form lakes. This action of glaciers explains why there are so many lakes in northern North America, Europe and Asia, as compared with the southern parts of those continents. For example, Finland has thousands of lakes formed by the action of glaciers. The Great Lakes in North America were also formed partly by glacial action. Many lakes in mountain regions occupy armchair-shaped basins, called *cirques,* which were worn out by glaciers. Other lakes are formed when blocks of ice are buried in glacial deposits. When the ice melts, the sediments slump down to form hollows, called *kettle holes,* which fill with water.

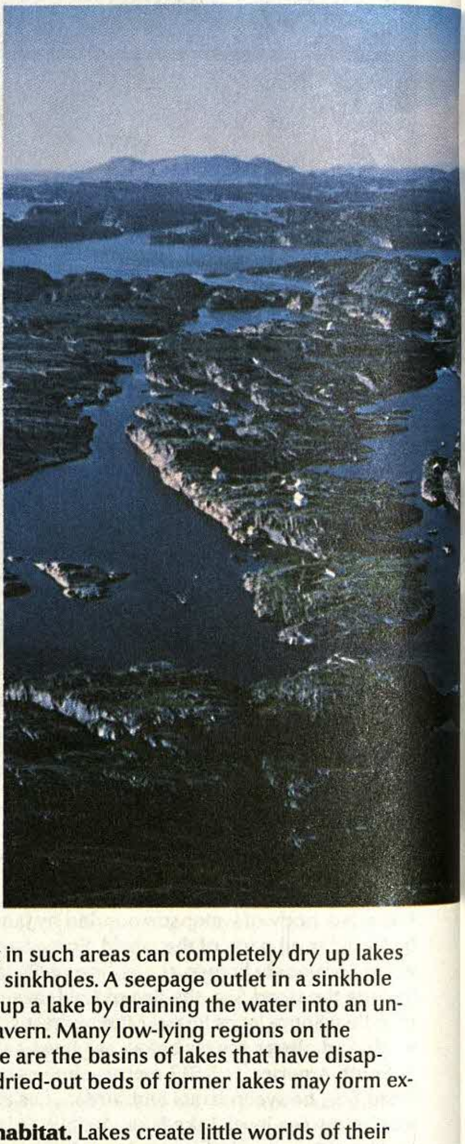
Some lakes form in limestone regions, such as the Florida peninsula in the United States. In limestone regions, rainwater which is slightly acid slowly dissolves the rock, forming networks of underground passages. When the tops of subterranean passages collapse, a depression, or *sinkhole,* appears on the surface. Some sinkholes become lined with clay which stops the water escaping. When these sinkholes become filled with water, they form lakes.

Lakes form in several other ways. Lake basins can be formed by movements in the earth's crust known as *faulting.* Lake Baikal in Russia, the world's deepest lake, was formed this way. Some large lakes cover the floors of deep rift valleys, such as those in eastern Africa (see **Great Rift Valley**). Other lakes, such as Lake Toba on the Indonesian island of Sumatra, form in the craters of extinct volcanoes. A few lakes, such as Lake Bosumtwi, Ghana, occupy large meteorite craters.

Some lakes, such as Lough Derg in Ireland, are wide sections of rivers. For example, Lough Derg is a wide section of the course of the River Shannon. Other lakes form when a river changes course. The bend of the river which is cut off from the main course forms a curved



Volcanic lakes form when water collects in the craters of extinct volcanoes. Poás Volcano in Costa Rica, *above,* contains a volcanic lake in one of its craters.



Glacial lakes form in areas where glaciers have worn out hollows in the earth's surface. The beautiful lakes, *right,* near Bergen, Norway, are glacial lakes.

oxbow lake. Oxbow lakes usually disappear after a while, because they are filled by sediment and vegetation. Other lakes, called lagoons, form along coastlines behind beaches made up of sand and pebbles.

Dam construction creates artificial, lakes called *reservoirs.* The lake behind the dam in Kariba Gorge, on Africa's Zambezi River, is more than 282 kilometres long. Australia's Snowy Mountains Scheme contains several reservoirs which conserve water for irrigation and for producing hydroelectricity.

How lakes are fed. Rivers and mountain streams feed some lakes. Other lakes do not appear to have any water coming into them. They are actually fed by underground springs or streams. Still other lakes have inlets but no outlets. Basins in which lakes sometimes form when rivers flow into them are called *playas.* South Australia has many playas, containing such lakes as Lake Eyre, Lake Frome, and Lake Torrens.

How lakes disappear. The lakes that now exist will probably disappear in time. Some lakes dry up because of a change in climate or because of a change in the course of the waters that feed them. An erupting volcano or earthquake sometimes changes the surface of the surrounding region and causes lakes to disappear. In addition, lakes may drain into other bodies of water and vanish.

Ground water fills the sinkholes in limestone areas. A long drought in such areas can completely dry up lakes and ponds in sinkholes. A seepage outlet in a sinkhole may also dry up a lake by draining the water into an underground cavern. Many low-lying regions on the earth's surface are the basins of lakes that have disappeared. The dried-out beds of former lakes may form excellent soils.

The lake habitat. Lakes create little worlds of their own. Water plants of all shapes and sizes live under the surface of lakes. Some of the plants are attached to the lake bottom, and others float free. This vegetation provides food for water creatures such as bugs, snails, and fish. Lakes are also the favourite haunts of waterfowl such as ducks, geese, swans, flamingos, egrets, cranes, and others. Land animals use lakes for drinking water. They also obtain food from lakes in the form of fish, birds, and plant life.

The importance of lakes

Climate. The presence of large lakes in a region greatly influences the lives of the people living nearby. Lakes affect weather conditions over a large area. In summer, a lake never gets as warm as the land that surrounds it. As a result, breezes blowing over the water are cooled. In winter, a lake does not cool off as fast as the surrounding land, and may cause the climate to be warmer.

World's largest natural lakes

Lake	Location	Area In km^2	Length In km	Maximum width In km	Maximum depth In m
Caspian Sea*	Kazakhstan-Turkmenistan-Iran-Azerbaijan-Russia	372,000	1,201	483	995
Lake Superior	Canada-United States	82,103	563	257	406
Lake Victoria	Kenya-Tanzania-Uganda	69,484	418	241	82
Lake Huron	Canada-United States	59,600	332	295	229
Lake Michigan	United States	57,757	494	190	281
Aral Sea*	Kazakhstan-Uzbekistan	40,100	350	185	54
Lake Tanganyika	Burundi-Tanzania-Zambia-Zaire	32,893	676	48	1,435
Lake Baikal	Russia	31,499	636	79	1,620
Great Bear Lake	Canada	31,328	340	177	396
Lake Nyasa	Tanzania-Mozambique-Malawi	28,749	563	80	701

*Saltwater

Warm winds blowing off a lake in autumn make it possible for certain crops to grow especially well. The effects of lakes on climate are evident around North America's Great Lakes. For example, the warming influence of Lake Ontario, on the border between Canada and the United States, extends the growing season of southern Ontario province. This makes it possible to grow maize and various kinds of fruits which require a mild climate and a warm season before the harvest. Another Great Lake, Lake Michigan, has a marked effect on farms along its eastern shore. Cool spring winds delay the blossoming of fruit trees until the danger of a killing frost has passed. Warm winds in autumn allow the fruit crops to be harvested before the frost strikes.

Travel and trade routes. The growth of travel and commerce on the Great Lakes provides a typical example of people's use of lakes. The early explorers of North America used lakes and their connecting rivers as their chief travel routes. Some of these explorers paddled canoes up the St. Lawrence River to the Great Lakes.

Steamboats took the place of canoes as the civilization of white people expanded. Today, freighters, tugboats, and barges work their way along inland navigation routes on the Great Lakes, carrying raw materials to the industrial cities along the lakes. Products carried on the Great Lakes include coal, iron, and grain.

Irrigation. Lakes provide an important source of water for irrigation. Water may be fed from the lakes to farmers' fields by ditches or canals, or it may be pumped into an overhead system of sprinklers. People have built huge dams on rivers in desert areas to create reservoirs of water for irrigation. The Egyptians built the Aswan High Dam on the Nile River partly for this purpose. The dams on the Indus River provide water to irrigate 14.8 million hectares of desert land. These irrigated regions, which lie mainly in Pakistan, supply food for millions of people.

Water supply has been a serious problem ever since people started to live in towns and cities. Lakes offered a natural reservoir of water for early communities. But most cities today have outgrown such natural supplies, and people have built huge storage dams to provide additional water. The reservoirs formed by these dams sometimes lie far away from the city. For example, Perth, Western Australia, gets its water from reservoirs up to 80 kilometres away to the east and southeast.

Recreation. People use lakes for a variety of recreational activities. They flock to lakes to enjoy fishing, boating, swimming, water-skiing, and ice-skating. In many parts of the world, the provision of recreational facilities around lakes has become an important industry.

Related articles in ***World Book*** include:

Africa

Lake Albert
Lake Bangweulu
Lake Chad
Lake Edward
Lake Nasser
Lake Nyasa
Lake Tana
Lake Tanganyika
Lake Turkana
Lake Victoria
Lake Volta

Asia

Aral Sea
Caspian Sea
Dead Sea
Lake Baikal
Lake Balkhash

Australia and New Zealand

Lake Burley Griffin
Lake Eucumbene
Lake Eyre
Lake George
Lake Macquarie
Lake Manapouri
Lake Pedder
Lake Saint Clair
Lake Taupo
Lake Te Anau
Lake Torrens

North and South America

Crater Lake
Gatun Lake
Great Bear Lake
Great Lakes
Great Salt Lake
Great Slave Lake
Lake Agassiz
Lake Erie
Lake Huron
Lake Maracaibo
Lake Michigan
Lake Nicaragua
Lake Ontario
Lake Superior
Lake Titicaca

Europe

Caspian Sea
Lake Albano
Lake Bala
Lake Como
Lake Constance
Lake District
Lake Garda
Lake Geneva
Lake Ilmen
Lake Ladoga
Lake Lugano
Lake Maggiore
Lake Nemi
Lake of Lucerne
Lake of Thun
Lake Onega
Lake Peipus
Lakes of Killarney
Loch Lomond
Lough Derg
Lough Neagh
Windermere

Other related articles

Kettle hole
Lagoon
Lake Xochimilco
Limnology
Oxbow lake
Pond

Lake Agassiz was the largest glacial lake which once existed in North America. It covered much of the area of present-day Manitoba, Canada, and portions of neighbouring states and provinces. Lake Agassiz came into existence late in the Ice Age (see **Ice Age**). As the ice sheet which covered the area moved northeastward, it left a large, shallow basin behind it. Melting ice and river water filled the basin to form Lake Agassiz. When the ice continued to melt at the lake's north and east shores, the waters drained away toward Hudson Bay. Several smaller lakes, including Winnipeg, Winnipegosis, and Manitoba, were left in the deeper part of the area. The shorelines of the ancient lake are visible today. The plain of Canada's Red River of the North, one of the world's most fertile wheat-growing regions, is the former lake bed. Its rich soil was deposited by Lake Agassiz.

See also **Red River of the North.**

Lake Albano lies in the crater of an extinct volcano in west-central Italy. For location, see **Italy** (physical map). Ancient Romans took their holidays at this lake, then called *Albanus Lacus.* According to legend, the city of Alba Longa was founded here by Ascanius, son of the Trojan warrior Aeneas.

Lake Albert, also called Albert Nyanza, one of the sources of the Nile River, lies between Uganda and Zaire. It covers about 4,248 square kilometres. It is about 160 kilometres long and about 32 kilometres wide. The waters of Lake Albert come from Lake Edward to the south through the Semliki River, and drain out to the north by way of the Albert Nile. Lake Albert was named after the husband of Queen Victoria of Great Britain.

Lake Baikal, also spelled *Lake Baykal,* is the deepest lake in the world. It also contains more water than any other freshwater lake. Lake Baikal lies in southeastern Siberia, a part of Russia. It is 1,620 metres deep at its deepest point and consists of more than 20 per cent of the world's unfrozen fresh water. Lake Baikal covers an area of 31,499 square kilometres. The lake measures about 636 kilometres long and about 79 kilometres wide at its widest point. In 1967, Lake Baikal and the surrounding area, were established as a national park.

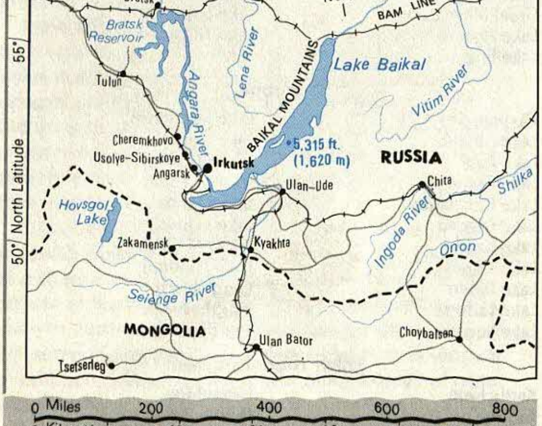
Lake Baikal is one of the world's oldest lakes. It was formed about 25 million years ago by movements of the earth's crust. Many kinds of wildlife live only in Lake Baikal or the nearby area. They include the golomyanka and other kinds of fish. The Baikal seal—found only in the lake—is one of the few kinds of seals that live in bodies of fresh water.

The large volume of water in Lake Baikal affects the weather in the surrounding area. For example, the area nearest the lake has temperatures several degrees warmer in winter, and cooler in summer, than places farther inland. The lake's surface is frozen from January to May. Although 336 rivers flow into Lake Baikal, only one, the Angara, empties out of it.

The chief products of the Lake Baikal region include cellulose, paper, timber, and fish. Hydroelectric dams on the Angara River supply power to the city of Irkutsk and other nearby communities.

Pollution from industries on the shores of the lake could endanger local wildlife. However, the Baikal Foundation was established in 1988 in order to evaluate the threats to the environment and to try to protect the lake's ecosystem.

Lake Baikal



Area: 12,162 sq. mi. (31,499 km²)
Elevation: 1,493 ft. (455 m) above sea level
Deepest Point: • 5,315 ft. (1,620 m)

Lake Bala is the largest lake in North Wales. It is 6 kilometres long and lies in Gwynedd. The long, narrow lake extends in a northeasterly to southwesterly direction. The River Dee flows through it. The name of the lake comes from the town of Bala, situated north of the lake. Llangower stands on the east shore. The Welsh call the lake *Llyn Tegid.*

Lake Balkhash is a large lake in the southeastern part of Kazakhstan. The lake lies 342 metres above sea level and has an area of 17,275 square kilometres. Lake Balkhash is only 10 kilometres wide in the eastern part, and 87 kilometres wide at the western end. The water in the western part of Lake Balkhash is fresh because of the inflow of the Ili River, but there is salt water at the eastern end. Several rivers empty into Lake Balkhash, but the lake has no outlet. Ice covers the lake from November to April. For the location of Lake Balkhash, see **Kazakhstan** (map).

Lake Bangweulu is a shallow depression about 80 kilometres long and 48 kilometres wide in northern Zambia (formerly Northern Rhodesia). For location, see **Zambia** (map). Much of the area to the south and southeast is swamp, which floods in the rainy season. The normal size of the lake is about 4,920 square kilometres, but the flood waters increase it to about 11,700 square kilometres.

The Luapula River, which flows out of the southern end of Lake Bangweulu, is one of the headstreams of the Congo River. David Livingstone, the British explorer, reached Lake Bangweulu in 1868. Livingstone died near the lake in 1873.

See also **Stanley and Livingstone.**

Lake Baykal. See **Lake Baikal.**

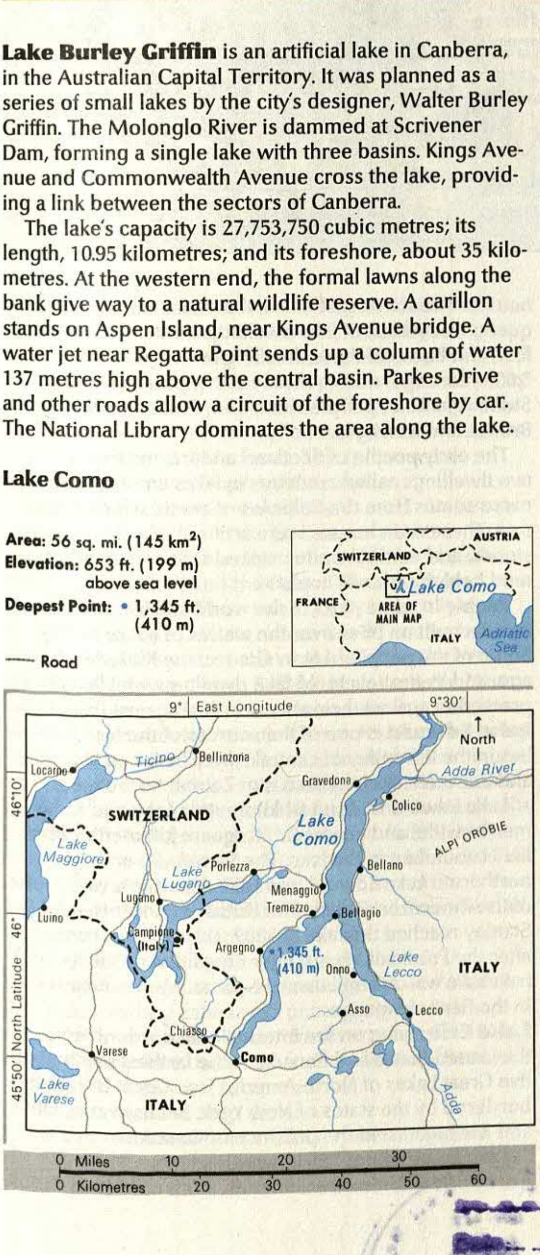
Lake Burley Griffin was created in the 1960's, when the Scrivener Dam was built across the Molonglo River. The lake is named after Walter Burley Griffin, the designer of Canberra.

Lake Burley Griffin is an artificial lake in Canberra, in the Australian Capital Territory. It was planned as a series of small lakes by the city's designer, Walter Burley Griffin. The Molonglo River is dammed at Scrivener Dam, forming a single lake with three basins. Kings Avenue and Commonwealth Avenue cross the lake, providing a link between the sectors of Canberra.

The lake's capacity is 27,753,750 cubic metres; its length, 10.95 kilometres; and its foreshore, about 35 kilometres. At the western end, the formal lawns along the bank give way to a natural wildlife reserve. A carillon stands on Aspen Island, near Kings Avenue bridge. A water jet near Regatta Point sends up a column of water 137 metres high above the central basin. Parkes Drive and other roads allow a circuit of the foreshore by car. The National Library dominates the area along the lake.

Lake Como

Area: 56 sq. mi. (145 km²)
Elevation: 653 ft. (199 m) above sea level
Deepest Point: • 1,345 ft. (410 m)
---- Road



Lake Chad is a large lake in north-central Africa. Most of it lies within Chad, and the rest lies in Nigeria, Cameroon, and Niger. For location, see **Chad** (map). Scientists think its average size expands and contracts in 10-year cycles, but its overall size has shrunk for many years. It now has an area of about 16,300 square kilometres. Its shoreline changes in relation to the quantity of water that rivers emptying into it pour into the lake, and the rate of water evaporation. It is much larger in rainy seasons than in dry seasons. Lake Chad is seldom deeper than 7 metres because its basin is so shallow that water overflows into the countryside. Many islands rise from the surface, which is covered by a tangle of grasses and weeds. This matted surface has caused many people to refer to the lake as "a drowned prairie." The lake's name in French is *Lac Tchad.*

Lake Como is a famous beauty spot of northern Italy. Lake Como is called *Lago di Como* in Italian. It lies in the province of Lombardy at the foot of the Alps. The lake covers an area of 145 square kilometres. Its shores are lined with handsome summer homes, fine gardens, and fertile vineyards. The Adda River runs through Lake Como. Thousands of tourists visit Como, the chief town on the lake, each year.

Lake Constance, called Bodensee in German, lies at the eastern end of the Swiss Plateau, at the border of Germany, Switzerland, and Austria. The lake covers 539 square kilometres. It is about 72 kilometres long and 16 kilometres wide. Of glacial origin, Lake Constance occupies a basin in the Rhine River. The level of the lake rises and falls with the melting of ice and snow in the neighbouring Alps. Many towns and villages line the shore of the lake, including Constance and Romanshorn. Old castles, monasteries, and churches dot the countryside. There are vineyards and orchards near the shore of Lake Constance.

Lake District is a beautiful region of lakes and mountains in the county of Cumbria, in northwestern England. It is about 48 kilometres from north to south, and 40 kilometres from east to west.

The region contains 15 lakes. They include Coniston Water, Ullswater, Derwentwater, Buttermere, Windermere, Grasmere, Thirlmere, Crummock Water, and Ennerdale Water. Some mountains in the region rise more than 900 metres above sea level, such as Scafell, Helvellyn, Skiddaw, and Scafell Pike, England's highest moun-

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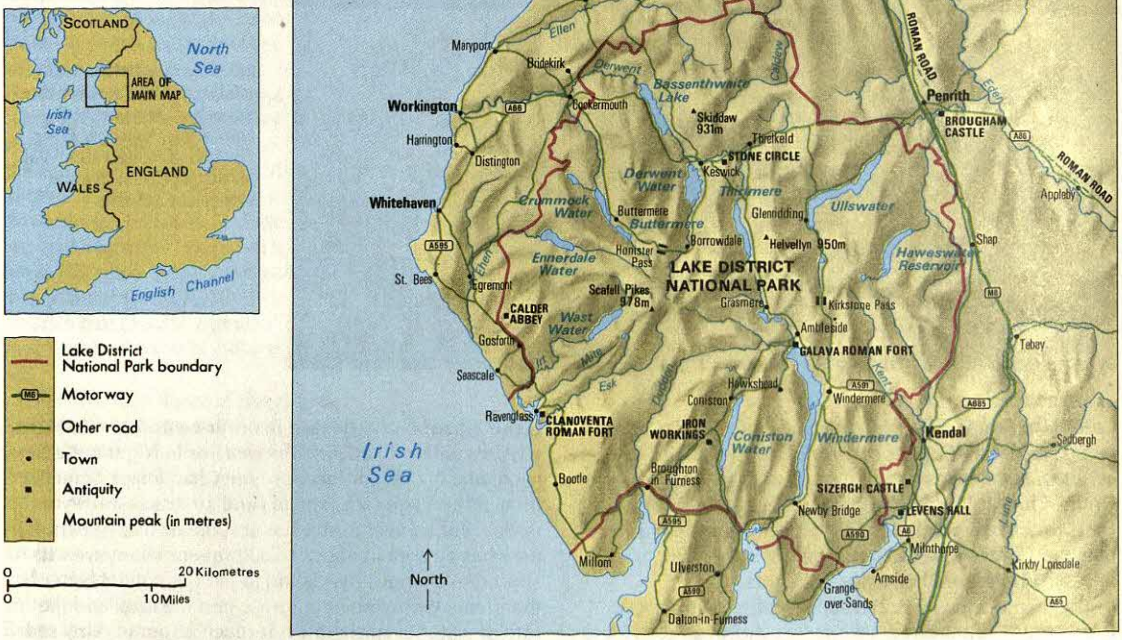
Lake District



tain. The chief towns in the Lake District are Ambleside, Keswick, and Windermere.

The Lake District has attracted many writers and artists. The region is closely associated with the romantic movement in English poetry. The poets Samuel Taylor Coleridge, Robert Southey, and William Wordsworth immortalized the Lake District in their poems. They became known as the *Lake Poets.* The writers Thomas Gray, John Keats, John Ruskin, Percy Bysshe Shelley, and Alfred Lord Tennyson were also associated with the Lake District. See also **Cumbria.**

Lake dwelling. Early peoples in Europe sometimes built dwelling places in lakes or at the edges of lakes or creeks. Scientists have come to call these houses lake dwellings. The people placed their houses on wooden platforms which stood on *piles,* or posts. They drove the foundations deep into the mud, and often held them steady by stones stacked around their bases. Some houses were clustered in villages.

The Greek historian Herodotus, who lived in the 400's B.C., made the first known mention of lake dwellings. He wrote of a lake-dwelling community in Macedonia. Archaeologists first found the remains of prehistoric lake houses in 1853, in a lake near Zurich, Switzerland. The relics had been preserved by the waters of the lake, and by the mud of the lake bottom. Since 1853, scientists have found the ruins of lake dwellings in various parts of Switzerland and also beside the lakes and streams of other countries in Europe. They have found weapons of bone, stone, and metal, as well as crude pottery bowls and dishes, near the sites of the lake dwellings. Some of the pottery vessels still contained cereal grains and fruits. Scientists believe the pottery and weapons belonged to the owners of the lake dwellings.

Archaeologists have used the ruins of lake dwellings to learn about the early people who built the wooden houses. The scientists believe that there was a sequence, or series, of lake dwellings built in Europe. The first, and finest, of these dwellings were put up about 5,000 years ago, during the Neolithic period, or New Stone Age. Later peoples built lake dwellings during the Bronze and Iron ages.

The early people of Scotland and Ireland built primitive dwellings called *crannogs* in lakes and bogs. The name comes from the Celtic word *crann,* which means *tree.* These rude houses were artificial islands of wood, stones, and earth. Wooden stakes driven deep into the mud held the islands in place.

People in some parts of the world still live in wooden houses built on piles over the waters of a lake or bay. Some of the people of New Guinea, the Malay Archipelago, and Venezuela build lake dwellings which serve as protection against their enemies, and against floods.

Lake Edward is one of the sources of the Nile River. It lies in the Rift valley of central Africa between Uganda and Zaire. Most of the lake is in Zairian territory.

Lake Edward is about 64 kilometres long and 51 kilometres wide, and covers 2,150 square kilometres. Fish life is abundant in the lake. The Semliki River flows north from Lake Edward into Lake Albert in a valley west of the Ruwenzori Range. The British explorer Henry M. Stanley reached the lake in 1889. The explorer named it after the Prince of Wales, later King Edward VII. Its original name was Albert Edward Nyanza. *Nyanza* means *lake* in the Bantu language.

Lake Erie, lying on the international border between the United States and Canada, is the farthest south of the five Great Lakes of North America (see **Great Lakes**). It is bordered by the states of New York, Pennsylvania, Ohio, and Michigan, and the province of Ontario.

Lake Erie is about 386 kilometres long, and ranges from 61 to 92 kilometres in width. With an area of 25,667

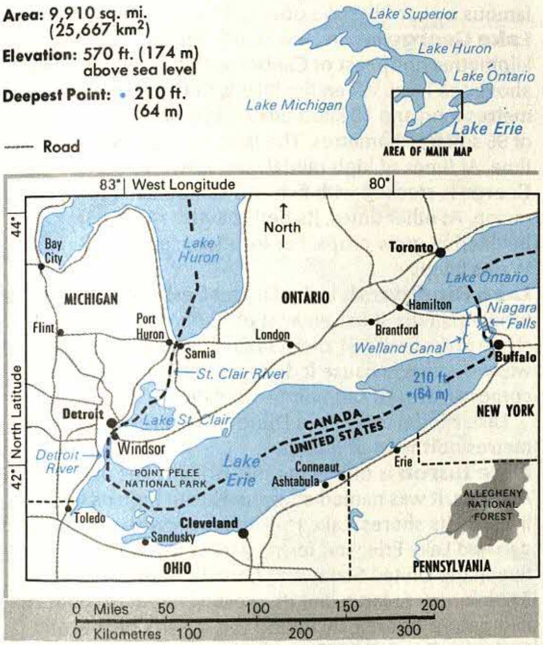
Lake Erie

Area: 9,910 sq. mi. (25,667 km^2)

Elevation: 570 ft. (174 m) above sea level

Deepest Point: • 210 ft. (64 m)

---- Road



square kilometres, it is the fourth largest of the five Great Lakes. It is a shallow lake, only 64 metres deep at its deepest point. For this reason, the lake is quickly stirred by storms and often has violent waves. French explorers called Lake Erie *Lac du Chat* (Lake of the Cat) because the Iroquois Indians called the tribe of Indians living near the lake *Erieehronons.* This Indian word probably meant *the people of the panther.*

Lake Erie lies between Lake Ontario and Lake Huron, and is one of the links in the St. Lawrence system. It receives the waters of Lake Huron through the St. Clair River, Lake St. Clair, and the Detroit River. It drains through the Niagara River into Lake Ontario. It is also connected to Lake Ontario, which lies 99 metres below Erie's level of 176 metres above sea level, by the Welland Canal. Eastward from Buffalo, New York, the New York State Barge Canal System joins Lake Erie with the Hudson River and the Atlantic Ocean. Much of the heavy lake traffic terminates on Erie's southern shore. Iron ore and taconite from Minnesota and limestone from Michigan are shipped to Ohio ports for use in Ohio steel mills and for mills in Pittsburgh, Pennsylvania. Buffalo is the most important grain-shipping port on the lake, and Toledo, Ohio, ships coal. The main Lake Erie ports are Toledo, Sandusky, Cleveland, Ashtabula, and Conneaut, all in Ohio; Erie, Pennsylvania; and Buffalo.

Industries and cities have polluted Lake Erie by dumping waste chemicals and sewage into it. Pollution has greatly reduced the lake's once-abundant fish supply and its recreational value. However, since the 1970's, conservation efforts have reduced the lake's pollution, and the fish supply has increased.

See also **Welland Ship Canal.**

Lake Eucumbene is an artificial reservoir located in the Snowy Mountains of New South Wales, Australia. It was formed by the Eucumbene Dam, which provides the major regulating storage for the Snowy Mountains Hydro-Electric Scheme. The dam was completed in 1958. The first transmountain diversion of water from Lake Eucumbene to the Tumut River was accomplished by the completion of the Eucumbene-Tumut tunnel in 1959. The Murrumbidgee-Eucumbene tunnel began operations in 1961.

The first stage of the Snowy-Murray development was the Eucumbene-Snowy project, involving the construction of Island Bend Dam and the Eucumbene-Snowy tunnel. It began diverting water from the Snowy River into Lake Eucumbene in 1965.

The nearest large town and railhead is Cooma. Tourist activities include launch excursions on the lake, trout fishing, and camping. Tourist resorts include Buckenderra, Old Adaminaby, Illawong, Providence, and Braemar.

See also **Snowy Mountains Scheme.**

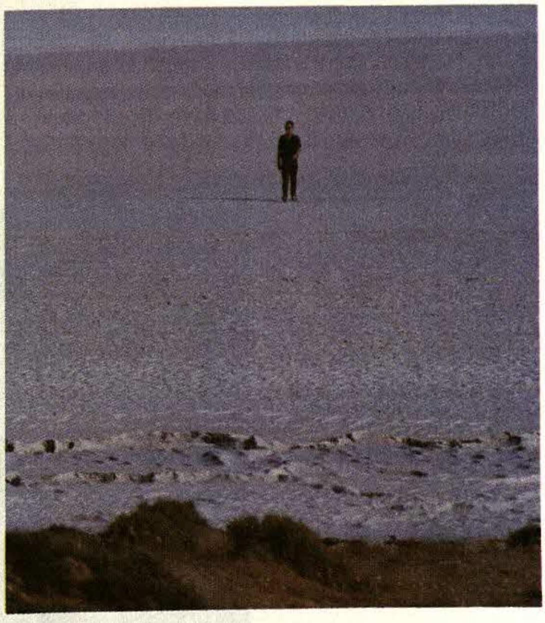
Lake Eyre is the largest lake in Australia. It lies in central northern South Australia. For location, see **South Australia** (map). Lake Eyre is nearly divided into two lakes, which are joined by the narrow Goyder channel.

The northern part of Lake Eyre is 145 kilometres long and 64 kilometres wide, and the southern part is 61 kilometres long and 26 kilometres wide. The lake covers 9,583 square kilometres.

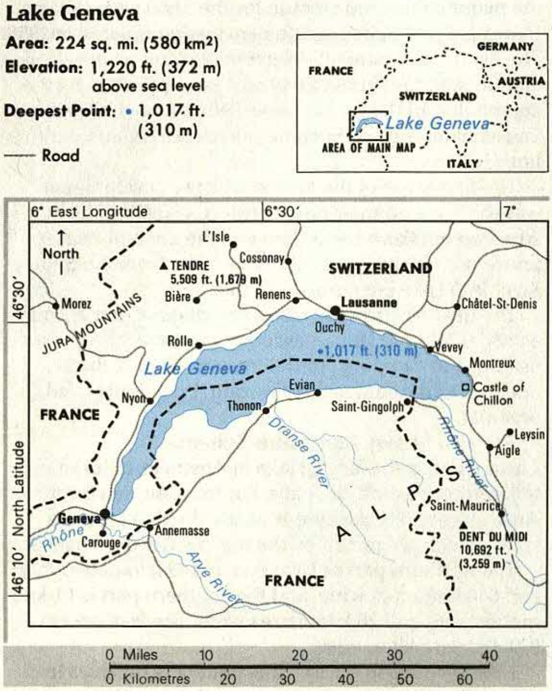
Lake Eyre lies in an area that generally receives less than 127 millimetres of rain a year. As a result, its surface is usually a dry area covered by a salt crust up to 4.5 metres thick. The lake is filled only in times of unusual rainfall, such as in 1949, 1950, 1973, and 1974.

Lake Eyre was discovered by the British born explorer Edward John Eyre in 1840. The lake was named in honour of Eyre in 1860.

Lake Garda is the largest lake in Italy. It is about 56 kilometres long and covers an area of 370 square kilometres. Lake Garda lies in beautiful Alpine country



Lake Eyre is normally a dry area covered by salt.



about midway between Milan and Venice. For location, see **Italy** (physical map).

Lake Geneva is one of the largest lakes in central Europe. It is formed by a natural damming of the Rhône River along the border between Switzerland and France. The crescent-shaped lake is 70 kilometres long, and its width ranges from 2.5 to 15 kilometres. The lake has an area of 585 square kilometres. The French name for Lake Geneva is *Lac Léman,* and its German name is *Genfer See.*

Lake Geneva lies in an area of great beauty, with the Jura Mountains to the north and the French Alps to the south. The Swiss shore is heavily populated, and major rail lines and highways parallel the lake. Major cities on the lake include Geneva, Lausanne, Vevey, and Montreux, all in Switzerland. On an island near the eastern shore stands the historic castle of Chillon that was made famous by Lord Byron's poem, "The Prisoner of Chillon."

Lake George lies in New South Wales, Australia, 32 kilometres northeast of Canberra. It is about 600 metres above sea level. When the lake is full, it is about 25 kilometres long and 10 kilometres wide, and covers an area of 96 square kilometres. The lake dries up from time to time. At times of high rainfall and low evaporation, Lake George is stocked with fish and can be used for boat racing. At other times, its bed is a grassy plain that can be tilled to grow crops. For location, see **New South Wales** (map).

Lake Hindmarsh is the largest freshwater lake in Victoria, Australia. It has an area of 12,000 hectares. It has a shore line of over 64 kilometres, but it has a fluctuating water surface because it dries up in dry years and becomes an area of salt-encrusted flats.

Lake Hindmarsh lies in Dimboola Shire, about 5 kilometres northeast of Jeparit.

Lake Huron is one of the five Great Lakes of North America. It was named after the Huron Indians who lived on its shores. Lake Huron lies between Lake Michigan and Lake Erie, and forms part of the boundary between the United States and Canada. The lake is about 332 kilometres long, and its greatest width is about 295 kilometres. Its area, including the North Channel and Georgian Bay, is 59,699 square kilometres.

Huron lies at the same level as Lake Michigan, 176 metres above sea level. The deepest part of Lake Huron is 229 metres below the surface. The lake drains an area of about 133,902 square kilometres. The St. Marys River connects Lake Huron with Lake Superior, and the Straits of Mackinac connect it with Lake Michigan. The waters of Lake Huron flow into Lake Erie by way of the St. Clair River, Lake St. Clair, and the Detroit River.

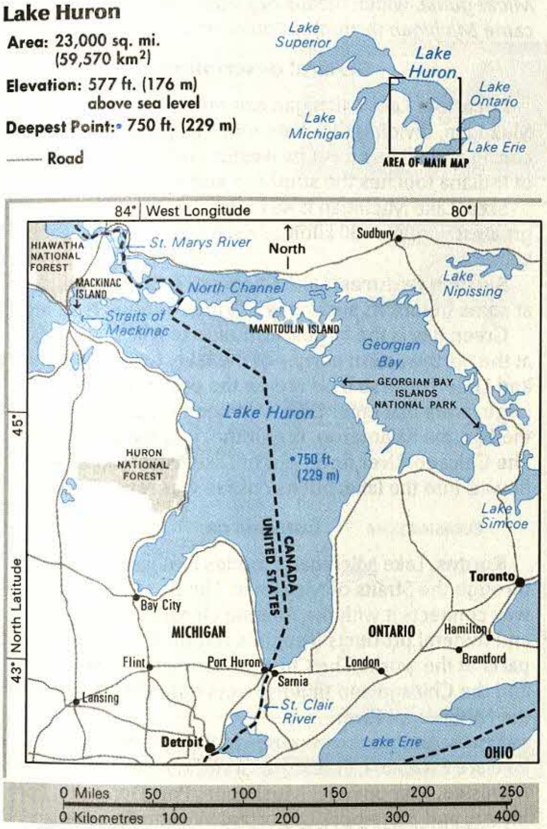
The clear waters of Lake Huron have many kinds of fish. Small islands dot the northern surface of the lake. The two most important islands are Mackinac Island, in Michigan, U.S.A., and Manitoulin Island, in Ontario, Canada. Violent storms between December and May make Lake Huron dangerous for shipping during the winter. The shores of the lake are low except on the southeastern coast, where rough cliffs rise 46 metres.

See also **Great Lakes.**

Lake George, near Canberra, normally has water, but it can dry up completely during periods of hot, dry weather.

Lake Huron

Area: 23,000 sq. mi.
(59,570 km²)
Elevation: 577 ft. (176 m)
above sea level
Deepest Point: • 750 ft. (229 m)
—— Road



Lake Ilmen is a freshwater lake in the northwestern part of Russia, just south of Novgorod. It is about 42 kilometres long and 34 kilometres wide. Rivers entering the lake include the Msta, Lovat', and Shelon'. Lake Ilmen empties north through the Volkhov River into Lake Ladoga. The Msta and Volkhov rivers are linked by two canals, parts of the waterway extending from the Baltic Sea to the Black Sea. For location, see **Russia** (terrain map).

Lake Ladoga, in northwestern Russia, is the largest lake located entirely in Europe. It covers 17,703 square kilometres. Lake Ladoga lies 64 kilometres northeast of St. Petersburg. For location, see **Russia** (terrain map). Along with Lake Onega to the northeast, Lake Ladoga forms part of a canal system that links the Baltic and White seas (see **Lake Onega**).

Until 1940 ownership of Lake Ladoga was divided between the Soviet Union, of which Russia was then part, and Finland. In that year, the Soviet Union took over the entire lake after a war against Finland.

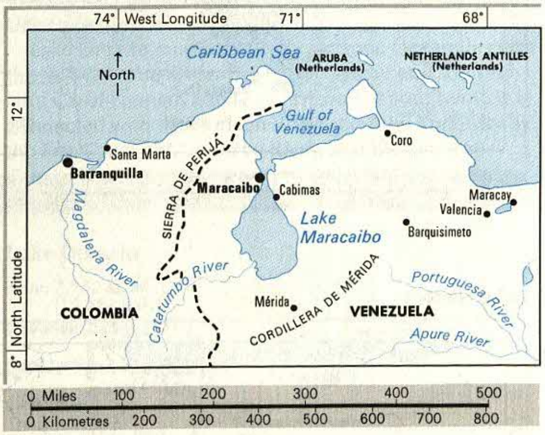
Lake Lugano lies at the southern foot of the Alps between Lakes Maggiore and Como. For location, see **Switzerland** (map). The Tresa River connects Lugano and Maggiore. Lake Lugano extends from northern Italy into southern Switzerland. It is 32 kilometres long and 3 kilometres wide. Italians call the lake *Lago di Lugano* or *Lago Ceresio.*

Lake Macquarie is a large coastal lagoon in New South Wales, Australia. It is about 100 square kilometres in area and is located about 15 kilometres south of Newcastle. It is fed by several small creeks, the largest of which are Dora Creek and Cockle Creek. Lake Macquarie opens into the sea at Lake Entrance, near the coastal town of Swansea. Other main towns on the lake shore are Toronto, Wangi Wangi, and Belmont. The Vales Point and Wangi thermal power generating stations draw their water supplies from the lake. The lake is a popular holiday resort, providing excellent boating and fishing.

Lake Maggiore is one of the best-known lakes in Italy. Most of it lies in Italy, but a small part in the north extends into Switzerland. The Italians call this lake *Lago Maggiore,* which means *greater lake.* Lake Maggiore is 64 kilometres long and covers 212 square kilometres. In some places the lake is more than 366 metres deep. High mountains rise to the north and west of the lake. On the south are hills covered with vineyards. The most important cities on the lake are Locarno, Palanza, and Streza. For location, see **Switzerland** (map).

Lake Manapouri is one of the most beautiful lakes in the South Island of New Zealand. The lake is also the site of a large underground hydroelectric power station. *Manapouri* is a Maori word meaning *lake of the sorrowing heart.* The lake is 19 kilometres long at its longest part, 10 kilometres wide at its widest part, and 433 metres deep. It is studded with islands. The area around Lake Manapouri is a popular holiday resort.

Lake Maracaibo



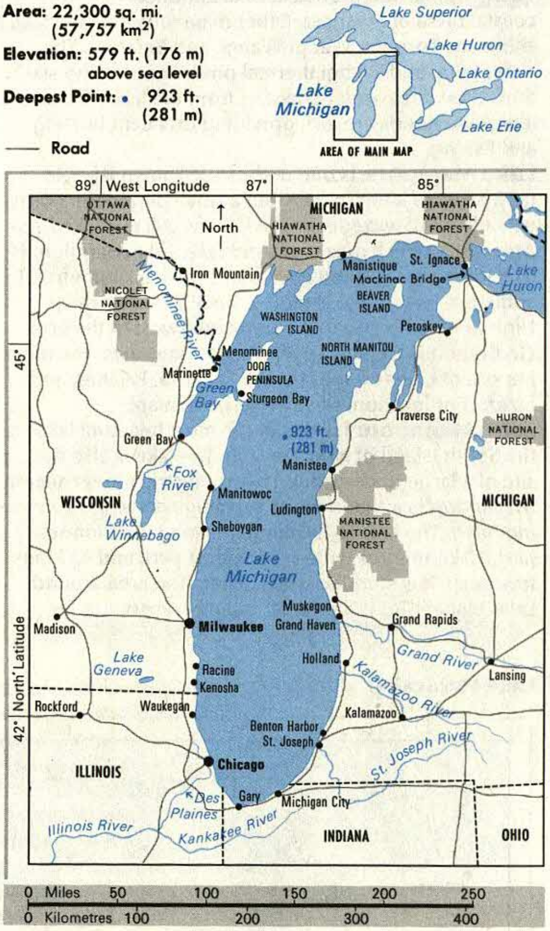
Lake Maracaibo is the trade waterway of the farming and rich petroleum region of northwestern Venezuela. Lake Maracaibo is the largest lake in South America. It covers 13,512 square kilometres. It is connected with the Caribbean Sea by a short channel and the Gulf of Venezuela. A bridge 8.9 kilometres long crosses the channel. The bridge is high enough to allow oceangoing ships to move under it. There are many oil wells in the lake and along its shores.

Lake Michigan is the largest body of fresh water in the United States. It is the third largest of the Great Lakes and the only one of the group that lies entirely inside the United States. Lake Michigan forms an important link in the great waterway system that reaches east to the Atlantic Ocean and south, through the Mississippi River, to the Gulf of Mexico.

Indians who lived on the shores of the lake called it

Lake Michigan

Area: 22,300 sq. mi. (57,757 km²)
Elevation: 579 ft. (176 m) above sea level
Deepest Point: ● 923 ft. (281 m)
—— Road



Michi-guma, which means *big water. Michi-guma* became *Michigan* through popular use.

General description

Location. Lake Michigan extends southward into Michigan, dividing that state into two peninsulas. Wisconsin and Illinois form its western border. A small part of Indiana touches the southern end of the lake.

Size. Lake Michigan is 494 kilometres long and its greatest width is 190 kilometres. It covers 57,757 square kilometres.

Surface features. Lake Michigan is 281 metres deep at some points. Its surface is 176 metres above sea level.

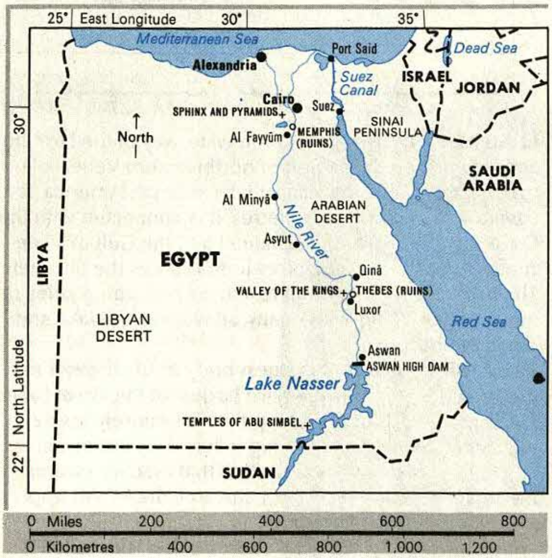
Green Bay is the largest arm of Lake Michigan. It lies at the northwestern corner of the lake. Grand Traverse and Little Traverse bays are on the east. Among the large rivers that enter Lake Michigan are the St. Joseph, the Fox, the Kalamazoo, the Grand, and the Menominee. The Chicago River flows out of Lake Michigan. It once flowed into the lake, but its course was reversed.

Commerce

Routes. Lake Michigan empties into Lake Huron through the Straits of Mackinac. The St. Lawrence Seaway connects it with the Atlantic Ocean. Lumber, grain, and mineral products from this region are shipped to all parts of the world. The Chicago Sanitary and Ship Canal and the Chicago and Illinois rivers connect the lake with the Mississippi River.

Ports. Among the important Michigan ports on the lake are Escanaba, Frankfort, Grand Haven, Ludington, Manistee, Menominee, Muskegon, Port Dolomite, Port Inland, and Stoneport. Important Wisconsin ports are Green Bay, Kewaunee, Manitowoc, Milwaukee, Oak Creek, Port Washington, Racine, and Sheboygan. Gary and Indiana Harbor are important Indiana ports. Chicago and Waukegan are the busiest Illinois ports on Lake Michigan.

Lake Nasser



Lake Nasser was formed when waters of the Nile River were blocked by the Aswan High Dam in Egypt. It was named after the president of Egypt, Gamal Abdel Nasser. The dam, which began operating in 1968, is 684 kilometres south of Cairo. The lake completely filled in 1981. It covers about 4,014 square kilometres. Water from the lake is used to irrigate land in times of water shortage and to generate hydroelectric power. The *Abu Simbel* temples, built by the pharaoh Ramses II, were cut out of cliffs along the Nile and moved to higher ground to escape the rising waters (see **Abu Simbel, Temples of**).

See also **Aswan High Dam.**

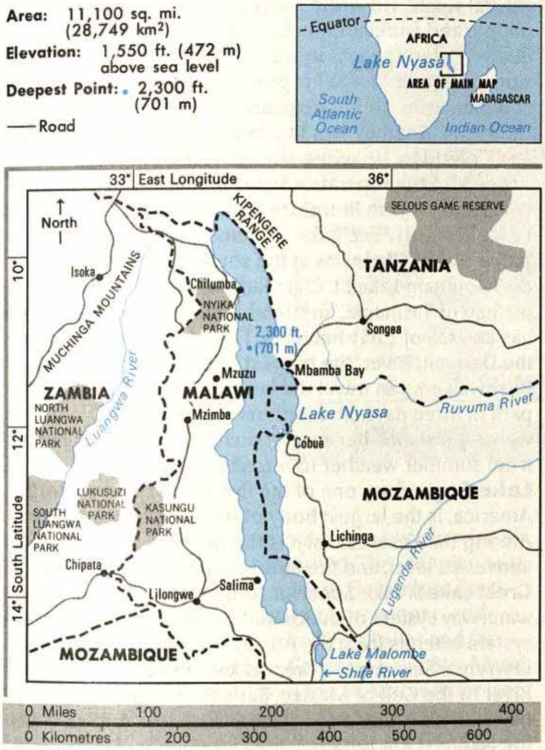
Lake Neagh. See **Lough Neagh.**

Lake Nemi lies about 24 kilometres southeast of Rome, Italy. For location, see **Italy** (physical map). It covers less than 2.6 square kilometres. Draining of the lake in the 1930's revealed remains of Roman pleasure boats.

Lake Nicaragua lies in western Nicaragua, about 19 kilometres east of the Pacific Ocean and 113 kilometres west of the Caribbean Sea. For location, see **Nicaragua** (map). The lake covers 7,925 square kilometres and is 154 kilometres long and 63 kilometres wide. Several large islands lie in the lake. Ometepe, the biggest, has two volcanoes. The Tipitapa River connects Lake Nicaragua with Lake Managua on the north.

Lake Nyasa

Area: 11,100 sq. mi. (28,749 km²)
Elevation: 1,550 ft. (472 m) above sea level
Deepest Point: • 2,300 ft. (701 m)
— Road



Lake Nyasa is the southernmost of a chain of large fresh-water lakes in the Great Rift Valley of eastern Africa. It lies about 640 kilometres inland from the Indian Ocean. Lake Nyasa, also called Lake Malawi, flows into the Indian Ocean by way of the Shire and Zambezi rivers (see **Malawi**). The lake is 563 kilometres long, and it has an area of 28,749 square kilometres. The waters of Lake Nyasa are 701 metres deep.

Lake of Lucerne is the scene of some of the adventures of the legendary Swiss patriot, William Tell (see **Tell, William**). It lies in central Switzerland. For the location of the Lake of Lucerne, see **Switzerland** (map). The lake's German name is *Vierwaldstätter See,* or *Lake of Four Forest Cantons.* Four wooded *cantons* (states)—Lucerne, Schwyz, Uri, and Unterwalden—surround it. The Lake of Lucerne covers 114 square kilometres. It has the form of a rough cross, 39 kilometres long and 3 kilometres wide.

Lake of Thun lies 558 metres above sea level in the Bernese Alps, a popular tourist region in west-central Switzerland. Interlaken is nearby. For the location of the Lake of Thun, see **Switzerland** (map). The lake is formed by the Aare River, and receives the waters of the Simme River at its western end. The Lake of Thun is 16 kilometres long and averages about 3 kilometres in width. It covers 47 square kilometres.

Lake Ohrid. See **Albania** (Land).

Lake Onega is one of the largest lakes in Europe. It lies in northwestern Russia. For location, see **Russia** (terrain map). The lake is part of the canal system that connects the White and Baltic seas.

Lake Onega has an area of 9,894 square kilometres. Lake Onega empties into Lake Ladoga, about 110 kilometres to the southwest, through the Svir River. It joins the Volga and northern Dvina rivers by a series of rivers and canals.

Lake Ontario is the smallest and most eastern of the five Great Lakes of North America. It forms an important link in the St. Lawrence Seaway system. Although Lake Ontario is open to large ships throughout the year, it has less traffic than the other Great Lakes.

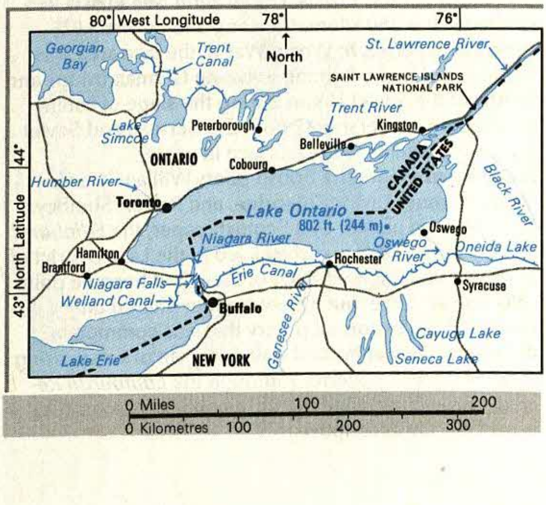
Lake Ontario lies between the province of Ontario in Canada and the northwestern part of New York in the U.S.A. The lake is about 311 kilometres long and 85 kilometres wide. It covers an area of 19,554 square kilometres. The shore of the lake is about 772 kilometres around. Offshore, the lake is very deep, ranging from 152 to 244 metres. Its surface lies 75 metres above sea level. The great depth of the lake, together with its low-lying surface, means that two-thirds of its waters lie below sea level and are not touched by surface winds and currents. A steady top current moves across the lake from west to east at a rate of about 0.5 kilometre per hour.

Lake Ontario does not freeze in winter, except along the shore, where the water is more shallow. The depth of its waters makes its surface cooler than the air above in summer, and warmer in winter. So the lake has a moderating effect on the climate of the area. The eastern outlet of the lake never has a really hot day, and the temperature of the southern shore is so moderate that fruit trees grow throughout this region on both sides of the United States-Canada border.

Lake Ontario empties into the Atlantic Ocean through the St. Lawrence River. The Niagara River and the Welland Canal connect it to Lake Erie on the southwest. It is connected with the Hudson River and New York City by the Erie Canal, the Genesee River, and the Oswego Canal. The rivers that empty into Lake Ontario include the Black, Genesee, Oswego, Trent, and Humber. The

Lake Ontario

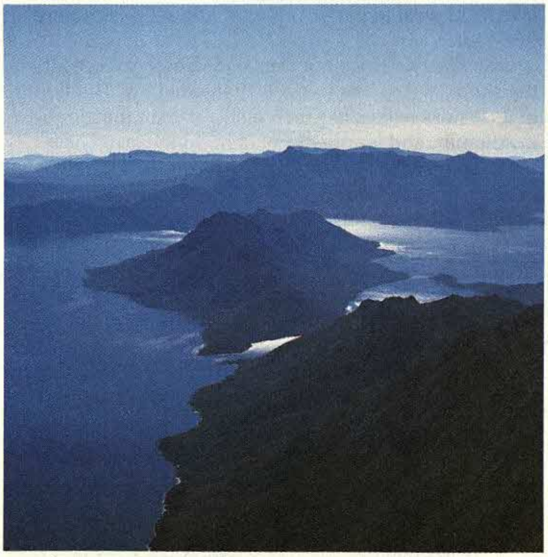
Area: 7,550 sq. mi. (19,554 km²)
Elevation: 245 ft. (75 m) above sea level
Deepest Point: • 802 ft. (244 m)
— Road



lake has many good harbours. The chief lake ports include Rochester and Oswego, New York. Important Canadian ports are Cobourg, Toronto, Hamilton, and Kingston.

See also **Great Lakes; Welland Ship Canal.**

Lake Pedder is in the South-West National Park of Tasmania, an island state of Australia. The lake was originally famous for its sandy beaches, where small aircraft could land with parties of bushwalkers. In the 1960's, the Tasmanian Hydro-Electric Commission made plans to build the 140-metre-high Gordon River Dam to harness the waters of the Gordon River to produce electricity. Conservationists protested vainly against the part of this scheme that involved enlarging Lake Pedder. The old beaches are now under water. The new Lake Pedder has an area of about 240 square kilometres. The 43-metre-high Scotts Peak Dam was built to help create the new Lake Pedder Reservoir, which attracts trout-fishing enthusiasts and tourists.



Lake Pedder, in southwestern Tasmania, stores water for the Gordon River power station.

Lake Peipus is a body of water on the border between Estonia and Russia. For location, see **Russia** (terrain map). It is 150 kilometres long and covers 3,626 square kilometres. In World War II, the lake area was the scene of heavy fighting between German troops and troops of the Soviet Union during the siege of Leningrad (now St. Petersburg). Both the German and Soviet troops crossed its frozen surface in winter.

Lake Poets were the British poets William Wordsworth, Samuel Taylor Coleridge, and Robert Southey. They were so named by a Scottish paper, the *Edinburgh Review* in 1817 because they lived in the Lake District of northwestern England. Each of them had become politically conservative, but otherwise they shared only a dislike of the stuffy, formal poetry that was common in their time. They cultivated a simple style of verse, using realistic speech patterns. Although the *Edinburgh Review* originally applied the term *Lake Poets* scornfully, it is now purely descriptive.

Wordsworth celebrated spiritual experience in the natural world. He wrote many poems about humble people and familiar objects, using conversational language. Coleridge was more philosophical and more visionary. In addition to his poems, he wrote important commentaries on Shakespeare and other works of critical theory. Southey was less talented than Wordsworth and Coleridge. He wrote tales in verse and history.

See also the separate articles on each of the Lake Poets and **English literature** (Romantic poetry).

Lake Rudolf. See **Lake Turkana.**

Lake Saint Clair lies at the southern end of the Cradle Mountain-Lake St. Clair National Park on the central plateau of Tasmania, an island state of Australia. The lake has an area of 2,851 hectares. The lake is the source of the Derwent River, the biggest river in the island. Bushwalkers can travel the length of a track through the park in three days. Shelter huts are placed within easy walking distance because of possible sudden changes from summer weather to blizzard conditions.

Lake Superior, one of the five Great Lakes of North America, is the largest body of fresh water in the world. Among the Great Lakes, it is the deepest, the highest above sea level, and the farthest north and west (see **Great Lakes**). Lake Superior forms part of the interior waterway system of the United States and Canada. This system extends from the Atlantic Ocean through the St. Lawrence Seaway, the Great Lakes, and the Mississippi River to the Gulf of Mexico. Early French fur traders gave the name *Lac Supérieur,* French for *Upper Lake,* to the lake.

Location and size. Lake Superior lies across the international border between the United States and Canada. The Canadian province of Ontario is to the north and east of the lake. Michigan and Wisconsin, in the U.S.A., lie to the south of the lake, and Minnesota to the west.

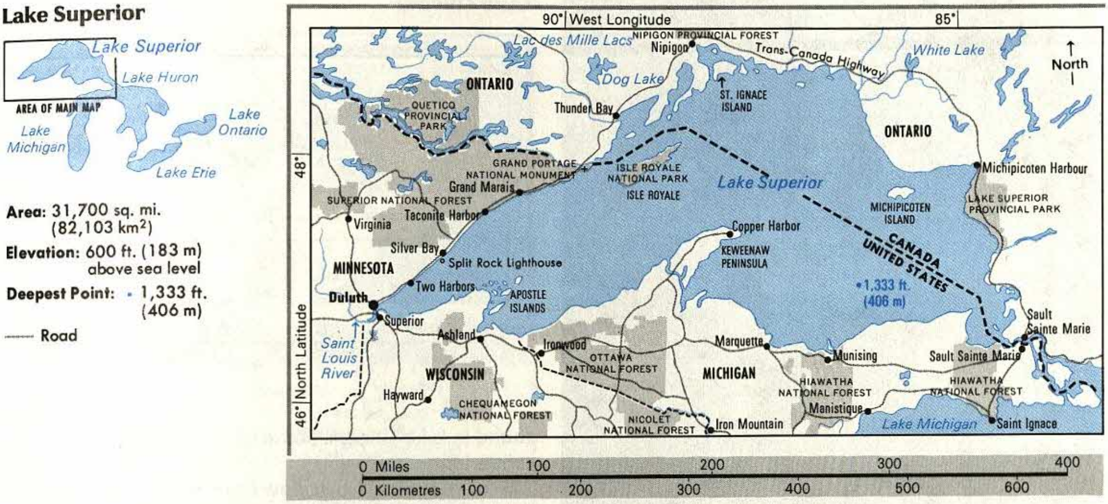
Lake Superior covers 82,103 square kilometres. Its greatest length from east to west is 563 kilometres, and its greatest width is 257 kilometres. The lake lies about 183 metres above sea level, and is 406 metres deep at its deepest point.

Description. The coastline of Lake Superior is bold and rocky. In some places, especially along the northern shore, cliffs rise from the water's edge. Colourful sandstone walls, known as the Pictured Rocks, rise along some areas of the lake's shore in Michigan. The road that follows the rocky Minnesota shore is lined with summer resorts, fishing villages, and state parks. Split Rock Lighthouse, a landmark, warns lake shipping from reefs in Beaver Bay along the Minnesota shore.

Forests cover much of the land that borders the lake. About 200 rivers, most of them short, empty into Lake Superior. Many of these rivers form waterfalls that plunge over the high, rocky headlands. The largest river emptying into the lake is the St. Louis River, the extreme headwater of the St. Lawrence River. It drains into the lake's western end. The Keweenaw Peninsula, famous for its copper deposits, juts into the lake in Michigan.

Many islands dot the surface of the lake. The largest of these islands are Michigan's Isle Royale and Ontario's St. Ignace and Michipicoten. Many small islands, named the Apostle Islands, lie off the northern Wisconsin shore.

Lake Superior



Area: 31,700 sq. mi. (82,103 km²)
Elevation: 600 ft. (183 m) above sea level
Deepest Point: • 1,333 ft. (406 m)
—— Road

Commerce. The lake does not freeze over in winter, but frozen harbours restrict shipping. The shipping season extends from about mid-April to December. Boats carry iron ore, taconite, wheat, lumber, copper, and other minerals to ports along the Great Lakes and farther east. The locks of the Soo Canals in Sault Ste. Marie carry ships around the rapids of the St. Marys River (see **Soo Canals**). This river connects Lake Superior and Lake Huron. The chief ports on Lake Superior are Duluth, Two Harbors, Taconite Harbor, Silver Bay, and Grand Marais, all in Minnesota; Superior and Ashland, Wisconsin; Marquette, Michigan; and Thunder Bay and Michipicoten Harbour, Ontario.

Lake Tana, also called Tsana, lies in northwestern Ethiopia. For location, see **Ethiopia** (map). It serves as the main source of the Blue Nile, or Abbai River. The Blue Nile receives its colour from the silt-free water of Lake Tana. Lying 1,829 metres above sea level, Lake Tana is 76 kilometres long and 71 kilometres wide.

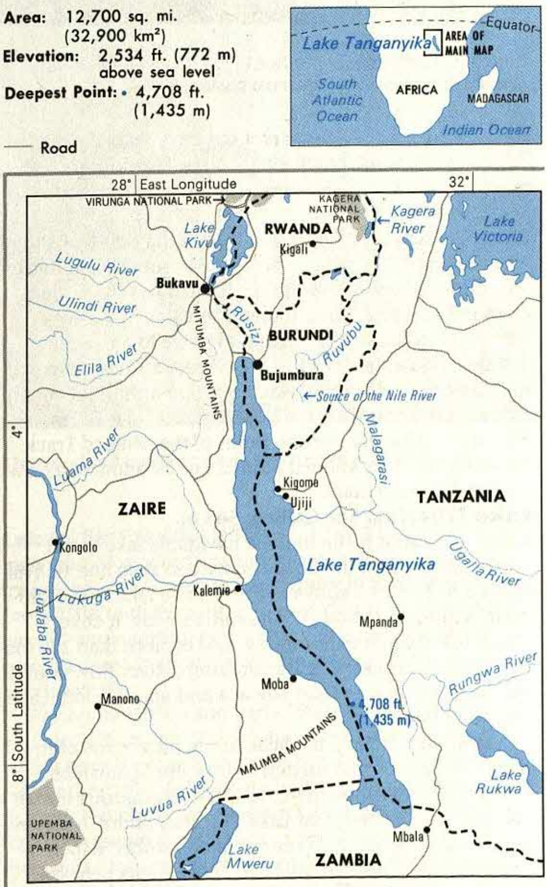
Lake Tanganyika, in east-central Africa, is the world's longest fresh-water lake and the second deepest. Only Lake Baikal, in Russia, is deeper. The lake is bordered by Burundi and Tanzania on the east and by Zaire and Zambia on the west. Lake Tanganyika is 680 kilometres long, and its greatest depth is 1,435 metres. The lake covers about 32,893 square kilometres. Lake Tanganyika's shores are mountainous. Only one major river, the Rusizi, drains into the lake. This river flows from Lake Kivu in the north. Lake Tanganyika's outlet is the Lukuga River.

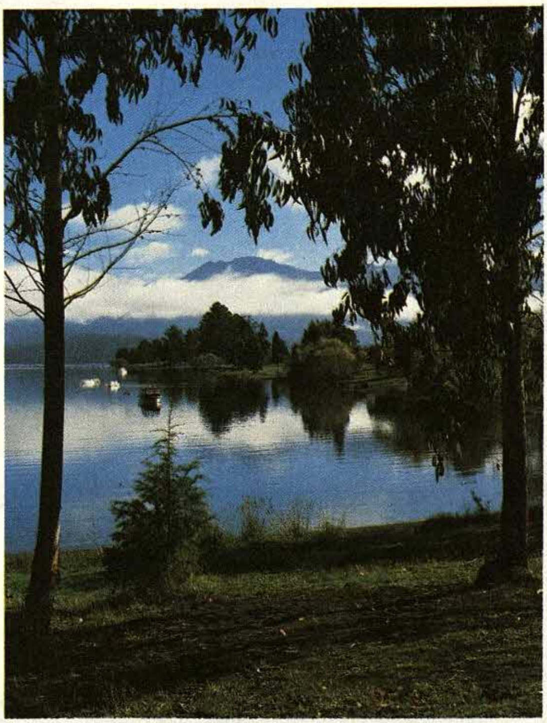
The first Europeans to see Lake Tanganyika were the explorers Sir Richard Burton and John Hanning Speke who reached Ujiji on the eastern shore in 1858. Henry M. Stanley found the missing missionary-explorer, Dr. David Livingstone, at the same point in 1871 (see **Stanley and Livingstone**).

Lake Taupo, situated almost in the centre of the North Island, is New Zealand's largest lake. It is 27 kilometres across at its widest point and is 40 kilometres long. The Waikato River, the longest river in New Zealand, flows from Lake Taupo. The township of Taupo, a trout-fishing centre, is near the northern edge of the

Lake Tanganyika

Area: 12,700 sq. mi. (32,900 km²)
Elevation: 2,534 ft. (772 m) above sea level
Deepest Point: • 4,708 ft. (1,435 m)
—— Road





Lake Te Anau is the largest lake in the South Island of New Zealand. It is also one of the most beautiful.

lake. To the south, visitors can see the volcanic peaks of Tongariro, Ruapehu, and Ngauruhoe. Hot springs rise from the earth in many places on the northern and southern shores.

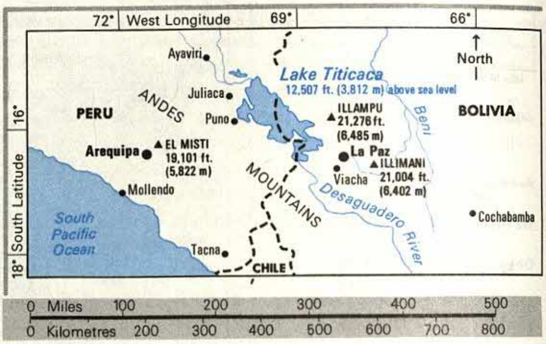
Lake Te Anau is the largest lake in the South Island of New Zealand. It covers an area of 344 square kilometres and is more than 64 kilometres long. It has three long channels that reach out to the mountains in the west. Many of the peaks around the lake rise to more than 1,800 metres above sea level. Te Anau, a small town at the southern end of the lake, is a popular holiday resort. Among the attractions are boat trips on Lake Te Anau. The lake is also the starting point of the Milford Track, a three-day walk to Milford Sound. For location, see **New Zealand** (terrain map).

Lake Tiberias. See **Galilee, Sea of.**

Lake Titicaca is the highest navigable lake in the world. Located on the border between Peru and Bolivia, it lies 3,812 metres above sea level. The lake is 180 kilometres long and about 72 kilometres wide. It covers about 8,300 square kilometres, and is more than 270 metres deep in places. The Desaguadero River flows out of the southern end of Lake Titicaca and empties into Lake Poopó in Bolivia.

Many islands lie in the lake. Some have ruins of Indian civilizations that existed before the Spanish conquest of South America in the 1500's. Numerous Indian villages are situated near Lake Titicaca's shore. Many villagers make boats from reeds called *totoras,* which grow on the shores of the lake. These boats provide transportation for local Indian commerce. Trout are found in Lake Titicaca. Some of these fish are about 1 metre long.

Lake Titicaca



Lake Torrens is a shallow body of salt water in South Australia. The lake is 193 kilometres long and 64 kilometres wide. It has an area of 5,776 square kilometres. For location, see **Australia** (terrain map).

Lake Trasimeno, Battle of. See **Hannibal** (His military campaigns).

Lake trout. See **Trout.**

Lake Turkana is a long, narrow lake in east-central Africa. Most of it lies in northern Kenya. Its northern tip extends into southern Ethiopia. For location, see **Kenya** (map). The lake covers an area of 6,405 square kilometres.

Lake Turkana is known for its plentiful supply of large fish, especially huge Nile perch. Turkana people inhabit the shore and fish and rear livestock for a living. Many Nile crocodiles breed in the Lake Turkana area. Koobi Fora National Park, on the lake's east shore, contains fossils of early forms of human beings and wildlife. Lake Turkana receives fresh water from rivers of the Ethiopian highlands. However, the lake has no outlet, and the region's hot, dry climate causes a high rate of evaporation of the fresh water. As a result, the lake's water is slightly salty.

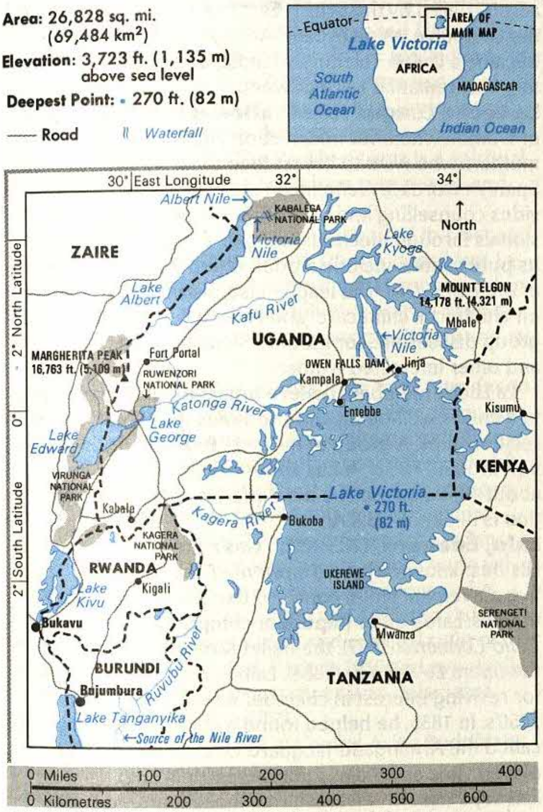
Lake Turkana first became known to Europeans after an expedition from Austria-Hungary reached it in 1888. The African people of the area then called the lake Basso Narok (Dark Water). The European expedition was led by Samuel Teleki, a Hungarian count. Teleki named the body of water Lake Rudolf in honour of Rudolf, the crown prince of Austria-Hungary. The lake is still sometimes called Lake Rudolf.

Lake Victoria, or, in Bantu, Victoria Nyanza, is the largest lake in Africa and the second largest freshwater lake in the world. Its area of 69,484 square kilometres is exceeded only by that of Lake Superior. Lake Victoria lies in east-central Africa, partly in Kenya, partly in Tanzania, and partly in Uganda. The equator crosses the lake.

Lake Victoria is the largest source of the Nile River. Owen Falls Dam, which was built across the Nile between 1949 and 1954, has raised Lake Victoria's level about 90 centimetres to an elevation of 1,135 metres above sea level. The lake's greatest depth is 82 metres.

In 1858, the English explorer John Hanning Speke be-

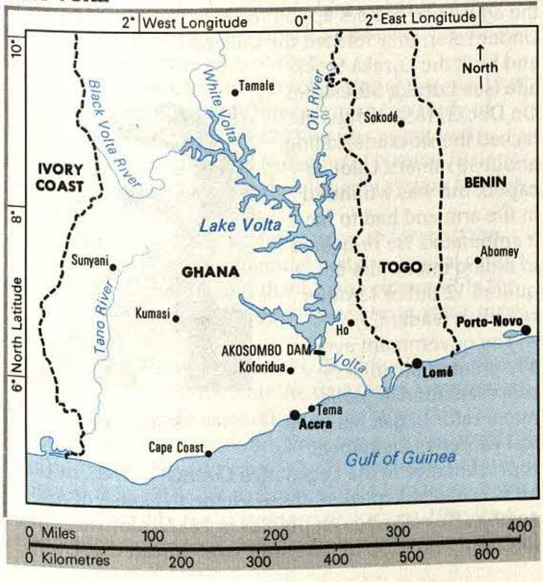
Lake Victoria



came the first European to reach Lake Victoria. He named the lake in honour of Queen Victoria.

Lake Volta, in central Ghana, is one of the world's largest man-made lakes. It is the reservoir behind Akosombo Dam on the Volta River. Lake Volta extends 402 kilometres north of the dam and was formed by the completion of the dam in 1965. The lake covers an area of 8,482 square kilometres. The power station at Akosombo Dam uses water from Lake Volta.

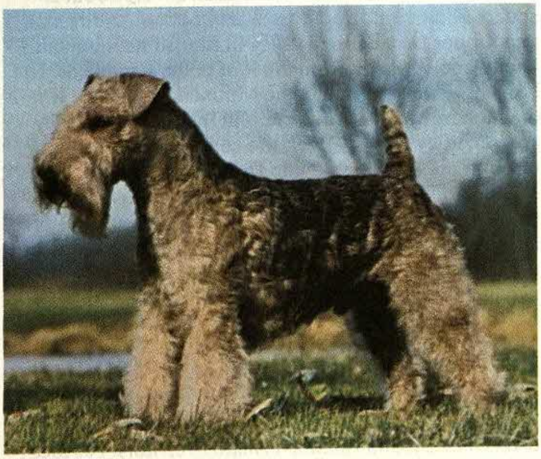
Lake Volta



Lake Windermere. See Windermere.

Lake Xochimilco, a swamplike lake in Mexico City, Mexico, is noted for its so-called "floating gardens." By the time the Spaniards conquered the region in 1521, the Indians had created five shallow lakes out of a larger one by building dikes. They heaped soft mud onto interwoven twigs, and made seed beds for flowers and vegetables. These "floating gardens" gradually increased in size and became anchored by the interlacing plant roots. Many tourists travel through the canals that separate these artificially created islands.

Lakeland terrier is a breed of dog that originated in the 1800's in the Lake District of northern England. It was developed to hunt foxes and protect sheep. This small dog has a rectangular head with a bearded chin. It has a soft undercoat and a wiry outer coat. The coat is usually tan with a reddish-black *saddlemark* (marking on the back and sides). The coat also may be a solid tan. The lakeland terrier weighs from 7 to 8 kilograms.

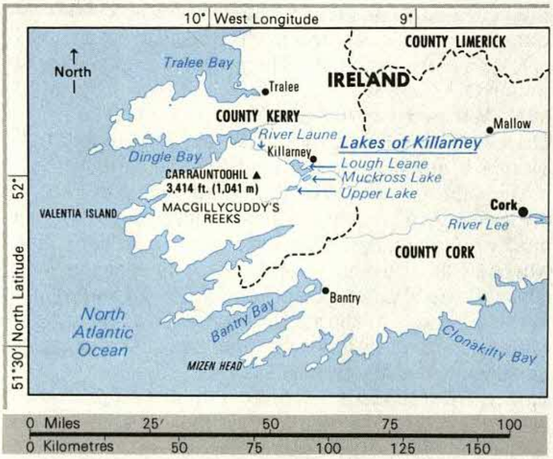


The lakeland terrier comes from northern England.

Laker, Sir Freddie (1922-   ), is a British businessman who pioneered cheap transatlantic air passenger travel. Laker was born at Canterbury in Kent, England. From 1938 until the end of World War II, he worked in aircraft engineering. In the late 1940's, he developed his own business buying, operating, and selling second-hand aircraft.

During the 1950's and early 1960's, Laker developed and ran airlines. In 1966, he launched Laker Airways, which became successful with charter operations. In September 1977, Laker launched Skytrain, an air service that offered cheap fares with no advance booking. Skytrain operated until 1982, when financial pressures forced its closure. Laker fought successfully in court to show that competing airlines had worked together to cause the closure.

Lakes of Killarney



Lakes of Killarney are three famous lakes of great beauty in County Kerry, in southwestern Ireland. They are one of Ireland's main tourist areas. The Lakes of Killarney lie southwest of the town of Killarney. Lough Leane, or Lower Lake, covers nearly 20 square kilometres. Muckross Lake, or Middle Lake, covers about 2.7 square kilometres. Upper Lake is about two-thirds that size. Upper Lake lies in a valley in sandstone mountains. The two lower lakes lie at the foot of the mountains. The lakes have their source in the Mountains of Kerry, where the highest point is Carrauntoohil (1,041 metres). They are joined by a lovely river, the Long Range. They drain through the River Laune into Dingle Bay.

Much of the lakes and surrounding mountains and woodlands form Killarney National Park. The centre of the park is at Muckross House and Gardens, on a peninsula that separates the lower lakes. Nearby are the ruins of Muckross Abbey, which was built in the 1400's.

Lakshadweep (pop. 51,681) is the smallest Union Territory of India. It is made up of a group of tiny coral islands, only 10 of which are inhabited. The islands occupy about 32 square kilometres in the Arabian Sea, off the coast of Kerala, and were formerly known as Laccadive, Minicoy, and Amindivi Islands Territory. For location, see **India** (physical map).

Most of the people rely on agriculture for their living. The women make an elastic fibre called *coir* from coconut husks. Coir is used in the manufacture of matting. The men build and sail boats, and trade on the mainland. They exchange copra and coir mainly for rice, their principal food.

Most of the islanders belong to various Arabian tribes. The main language is Malayalam. Some of the original inhabitants were Muslims, others were Hindus. The people of the island of Androth were perhaps the first in the area to be converted to Islam. Androth has long been regarded as the religious centre of the group. Preachers travelled from there to the other islands, spreading the teachings of Islam. Almost all the people on Minicoy are Christian women. Their menfolk work in the merchant navies of the world.

Lakshadweep was known to Arab explorers and geographers as long ago as A.D. 45. In the 1500's, Portuguese traders and settlers from the Indian mainland fought over the islands. In the 1800's, the islands were administered by the British East India Company. In 1956, the Laccadive, Minicoy, and Amindivi groups of islands became a Union Territory of India, and in 1973 the territory was renamed Lakshadweep.

La Leche League International is an organization of women who offer information and encouragement to mothers who want to breast-feed their babies. The Spanish words *la leche* mean *the milk.* The league provides counselling and education to parents and professionals through meetings, seminars, and publications. Its publications include a book called *The Womanly Art of Breastfeeding.* The league also distributes brochures on childbirth, child care, and related subjects. It directs group discussions for mothers who are breast-feeding and other interested women.

La Leche members believe breast-feeding contributes to a child's well-being and promotes good mother-child relationships. A group of mothers founded the organization in 1956. Today, it has about 3,600 local groups in about 40 countries. The headquarters of the organization is in Illinois, U.S.A.

Lalo, Édouard (1823-1892), was a French composer. His best-known work, *Symphonie Espagnole* (1875), is a five movement violin concerto that features Spanish themes. Lalo's other important compositions include the *Cello Concerto* (1877), the ballet *Namouna* (1882), and the opera *Le Roi d'Ys* (1888). Lalo was largely responsible for reviving interest in chamber music in France in the 1850's. In 1855, he helped found a chamber music group called the Armingaud-Jacquard Quartet in which he played viola and violin. Lalo was born in Lille.

Lalor, Peter (1827-1889), was the leader of the gold miners in Victoria, Australia, during the troubles at the Eureka Stockade in the mid 1800's. The miners were resentful because they had few rights as citizens, were not represented in the state parliament, and had to pay large fees for the right to mine gold. The miners began rioting in 1854. When the Victorian government sent troops to the Ballarat goldfield to quell the disturbances, the aggrieved miners appointed Lalor as their leader. Under Lalor, they formed the Ballarat Reform League and built the Eureka Stockade (see **Eureka Stockade**). On Dec. 3, 1854, troops attacked the stockade, killing about 30 miners. Lalor escaped, but was wounded in the arm and had to have it amputated. He remained in hiding until a jury acquitted 12 out of 13 other rebellion leaders.

The government eventually granted the miners representation in parliament. Lalor began his political career as the miners' representative in the Legislative Council in 1855. In 1880, he was elected speaker of the Victorian House of Assembly. He retired from politics in 1887. Lalor was born in County Laois, in Ireland, and was educated at Trinity

Peter Lalor

College, Dublin. He emigrated to Australia in 1852 to seek his fortune.

Lama is a priest of the Buddhist religion in Tibet or Mongolia. Lamas live in monasteries called *lamaseries.* The word *lama* means a superior, and is applied only to higher grades of monks. In Tibet, there are two chief lamas, called *grand lamas.* One, the Dalai Lama, is the leading religious authority. He was also the political ruler of Tibet until 1959. The Panchen Lama is a spiritual leader. Lamas officiate at all religious ceremonies and festivals. See also **Dalai Lama.**

Lamaism is a form of Buddhism practised in Tibet and Mongolia. It is sometimes called *Tibetan Buddhism.* Lamaism is named after the Buddhist *lamas* (monks), who teach the faith. Many Lamaists follow a branch of Buddhism called *tantrism,* which stresses meditation and secret rituals.

Shortly before A.D. 650, monks from India introduced Buddhism into Tibet. Through the years, Buddhism was combined with traditional Tibetan religious beliefs to form Lamaism. The Lamaists built monasteries called *lamaseries,* which became political and educational centres in Tibet. Between 900 and 1400, several Lamaist sects developed in Tibet. The most powerful one was called the Yellow Hat sect because its monks wore yellow uniforms. The sect leader became known as the *Dalai Lama.* From the mid-1600's until 1950, the Dalai Lama was the supreme political and spiritual ruler of Tibet. The Chinese invaded Tibet in 1950 and eventually removed the Buddhists from power. The Dalai Lama went into exile in India in 1959.

See also **Asia** (Way of life in Central Asia); **Buddhism; Tibet; Painting** (Indian painting).

Lamarck, Chevalier de (1744-1829), was a French biologist and botanist. He became one of the first to propose a theory of biological evolution. Lamarck was a founder of *invertebrate paleontology* (the study of fossils of animals without backbones).

From his work in botany, Lamarck concluded that plants and animals change their forms to adapt to their environment, and that these changes are passed along to their offspring. His studies of plant and animal life greatly aided the naturalist Charles Darwin in his development of the theory of evolution.

In 1788, Lamarck became conservator of the royal herbarium. He transferred his interest from the study of plants to that of animals. In 1793 he was appointed a professor of zoology at the Museum of Natural History in Paris. While teaching, he developed a system for classifying invertebrate animals.

Lamarck was the first scientist to try to forecast the weather. He published an annual meteorological report from 1799 to 1810. It is said that he was responsible for the names of the various cloud types: *cirrus, stratus, cumulus,* and *nimbus.*

Lamarck was born in Bazentin, Picardy. His real name was Jean Baptiste Pierre Antoine de Monet. He inherited the title Chevalier de Lamarck from his father. He studied briefly for the priesthood, then served as an army officer during the Seven Years' War. He started the study of medicine in 1768, but at the age of 24 began studying under the noted botanist Bernard de Jussieu. His views on evolution influenced thought in the 1800's. In his later years Lamarck was completely blind, but he continued his work with the assistance of others.

See also **Darwin, Charles Robert; Evolution** (Early theories); **Heredity** (Early ideas about heredity).

Lamartine, Alphonse de (1790-1869), was a French writer and statesman. The death of the woman he loved inspired some of his greatest poems. *Poetic Meditations* (1820), his first published collection, was a key work in the development of French romantic literature and won Lamartine fame. In this work, he expressed sadness and a yearning for the past, and told of the consolation he found in religious faith, the hope of immortality, and the memory of his ideal love. He began a vast work symbolically describing humanity's struggle to reach God by suffering and atonement. Only two episodes, *Jocelyn* (1836) and *The Fall of an Angel* (1838), were finished.

Alphonse Marie Louis de Prat de Lamartine was born in Mâcon. He served briefly as provisional chief of state after the Revolution of 1848. He lost his popularity, and he died heavily in debt.

Lamb is meat obtained from sheep that are less than 1 year old. Lamb is a red, tender meat with a delicate flavour. It is high in food value. It provides a good source of protein and B vitamins and is rich in the minerals phosphorus and iron. Lamb is a popular food in Australia, Great Britain, Greece, New Zealand, and many other countries. The meat obtained from sheep more than 1 year old is called *mutton.*

The quality of lamb is based on the age, shape, and fatness of the *carcass.* The carcass is the part of the butchered animal that remains after the skin, head, feet, and internal organs have been removed. Usually the grade is stamped on the carcass. Some grades for lamb are, from the highest to the lowest, prime, choice, and good. Supermarkets generally sell only prime and choice grades of lamb.

The lamb carcass is divided into seven wholesale cuts: leg, loin, flank, rack, breast, shoulder, and foreshank. Grocers may divide these wholesale cuts into smaller pieces for sale to consumers. Roasts, chops, and steaks are cut from the leg, loin, and rack. These tender cuts should be roasted or grilled. Small chops, however, may be fried. Many other lamb cuts are less tender and should be *braised* (cooked by moist heat in a covered pan) or cooked in liquid.

See also **Meat; Mutton; Sheep.**

Lamb, Charles (1775-1834), was an English author. He became famous for his informal, personal essays and his literary criticism. Lamb used the pen name *Elia* for many of his essays.

His life. Lamb was born in London and had a simple, outwardly uneventful life. His only formal education was at a London school called Christ's Hospital. The poet Samuel Taylor Coleridge was also a student there, and he and Lamb became close friends. In 1792, Lamb went to work as a clerk for the East India Company. He worked for the firm until his retirement on a pension at the age of 50. Lamb never married. He lived with his sister Mary, and took loving care of her even during periods when she was mentally unbalanced. Lamb's quiet devotion to his sister led the author William Makepeace Thackeray to call him "Saint Charles."

His essays. Lamb's reputation rests on his essays

Charles Lamb

and his literary criticism. But he also wrote a few undistinguished poems and two unsuccessful plays. His farce *Mr. H.* failed miserably at its first performance in 1806, and Lamb joined the audience in hissing his own play. Lamb's best and most popular essays appeared from 1820 to 1825 in *The London Magazine.* They were collected in two volumes known as *Essays of Elia* (1823) and *The Last Essays of Elia* (1833). Lamb's literary and dramatic criticism appears in his essays and in his notes to a collection of excerpts from Elizabethan plays. The notes and excerpts were published as *Specimens of English Dramatic Poets Who Lived about the Time of Shakespeare* (1808).

Lamb's writing reveals much about him—his gentle and whimsical nature, his great capacity for friendship, and his warm humanity. Some of his essays recall his youth. Others are character sketches of eccentric people in whom Lamb found something to like. Many of his essays discuss books and the theatre, both of which he loved.

The titles of some of Lamb's essays show the range of his interests—"Poor Relations," "Mrs. Battle's Opinions on Whist," "My First Play," "Dream Children," "A Bachelor's Complaint of the Behaviour of Married People," and "A Dissertation Upon Roast Pig." Even subjects that seemed ordinary came to life through his original, sympathetic point of view. In his essays, Lamb stayed close to common realities—"sun, and sky, and breeze, and solitary walks, and summer holidays, and the greenness of fields and the delicious juices of meats and fishes, and society, and the cheerful glass, and candlelight, and fireside conversations."

Behind Lamb's warmth and humour lay robust common sense. He scorned what he called "the namby-pamby." His literary criticism is highly individual and penetrating. Close friendships with such writers as Coleridge, William Wordsworth, Robert Southey, and William Hazlitt made him part of the romantic movement of the early 1800's. Yet Lamb could make fun of the solemnity of much of Wordsworth's poetry. When he called Coleridge "an archangel, a little damaged," and said that "he had a hunger for eternity," Lamb expressed what other critics might have taken a page to say. In his criticism of William Shakespeare and other dramatists, Lamb was attempting to get at the deepest realities of life and art.

Mary Ann Lamb (1764-1847), Charles's sister, fatally stabbed their mother in 1796 during a fit of temporary insanity. She was placed under Charles's guardianship, even though he was only 21. When normal, Mary was affectionate and intelligent. She worked with Charles in writing three books for children. The most famous is *Tales from Shakespeare* (1807). In retelling the stories of Shakespeare's plays, Charles wrote the tragedies and Mary wrote the comedies. Their other books for children are a collection of stories called *Mrs. Leicester's School* (1807) and *Poetry for Children* (1809). After Charles died, Mary lived on his pension and savings. She was born in London.

Lamb, William. See Melbourne, Viscount.

Lambay Island is a small island in the Irish Sea, off the coast of the county of Dublin, Ireland. It has an area of about 21 square kilometres. The island is a noted bird sanctuary. It is privately owned, and special permission must be obtained by visitors. Lambay was the scene of the first Viking raid on Ireland, in the A.D. 790's. The island has remains of fortifications that date from the 1500's.

Lambert, Constant (1905-1951), was an English composer, conductor, and author. He is best remembered for his ballet *Horoscope;* his piece *The Rio Grande* for piano, choir, and orchestra; and his *Eight Chinese Songs.* Lambert's works reveal the influence of classical music and of jazz. Much of his music is witty and charming. He was musical director of the Vic-Wells Ballet Company.

Lambert was born in London. He was educated at Christ's Hospital and at the Royal College of Music, where one of his teachers was the composer Ralph Vaughan Williams.

Lambert, George Washington (1873-1930), an Australian artist, painted *Across the Black Soil Plains.* This painting of a magnificent team of toiling Clydesdale horses earned him the New South Wales Society of Artists' Travelling Scholarship in 1899, and also the Wynne Prize in 1900. Afterward, Lambert modelled his style in painting and sculpture after the Florentine mannerist, Agnola Bronzino (1503-1572). Like Bronzino, Lambert attained extraordinary technical proficiency.

George Lambert was born in St. Petersburg, Russia, the son of American parents. His father died soon afterward, and his mother settled in Australia. Lambert became the most famous student of Julian Ashton, who ran the Sydney Art School, the best-known art school in Australia from 1900 to 1940.

Lambeth (pop. 220,100) is an English borough within the Greater London area. It consists of the former borough of Lambeth and part of the former borough of Wandsworth. Lambeth is on the south bank of the River Thames. Its northern boundary is the river, and it extends southward as far as the borough of Croydon. Famous places and buildings in the borough are Lambeth Palace; Kennington Oval cricket ground; County Hall; Waterloo Station; and the South Bank arts complex, including the Royal Festival and Queen Elizabeth halls, the National Theatre, the National Film Theatre, and the Hayward Gallery.

Lambeth Palace is the official residence of the archbishop of Canterbury, the spiritual leader of the state church of England. It is located in Lambeth, in southeast London, and is composed of a collection of buildings largely of medieval character. The north cloisters and the crypt are its oldest parts. The hall, rebuilt after the rule of Oliver Cromwell in the 1600's, houses a library founded at that time by Archbishop Bancroft.

Lamb's-quarters is a tall weed related to beet and spinach. It grows in fields and gardens and along roads in most of Europe, Asia, and North America. The plants range in size from 30 centimetres to 3 metres. Clusters of tiny greenish flowers hang from the stem. Lamb's-quarters is also called *pigweed* or *goosefoot*. It is a nuisance to farmers because the seeds become mixed with grain seeds. The tasty leaves are sometimes cooked and eaten as vegetables.

Scientific classification. Lamb's-quarters belongs to the goosefoot family, Chenopodiaceae. It is *Chenopodium album.*

Lamentations is a book of the Hebrew Bible, or Old Testament, that mourns the destruction of Jerusalem and the Temple in 587 or 586 B.C. According to tradition, Jeremiah, the prophet of the destruction, wrote this book. However, numerous scholars believe the content of Lamentations does not reflect the views of Jeremiah.

All five chapters of Lamentations are written in verse. The first four chapters are alphabetic acrostics, with each stanza (or three stanzas in chapter 3) beginning with a letter in order of the Hebrew alphabet. The first four chapters relate the dreadful conditions brought about by the destruction and mourn the degradation of Jerusalem. The author attributed these problems to God's punishment of the people for their sins. However, despite widespread despair, the author holds out hope for God's salvation. The fifth chapter ends with a plea for God to forgive and restore Israel.

See also **Tishah be-av; Jeremiah, Book of.**

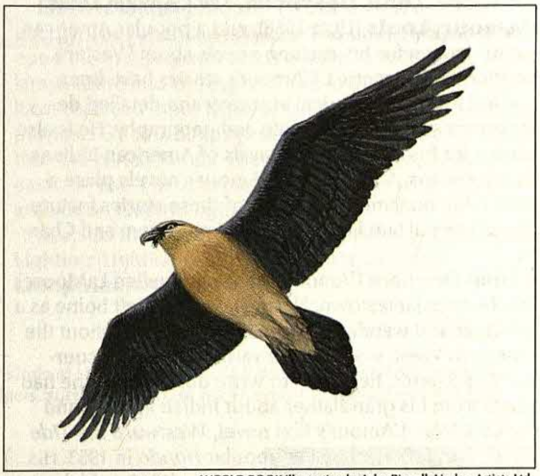
Laminated glass. See **Glass** (Speciality glasses).

Laminating is a process of permanently bonding together two or more pieces of wood or other materials with glues, pressure, and sometimes heat. Large laminated beams and arches are manufactured by assembling multiple layers of short pieces of wood with their grains running parallel to one another. The ends of the individual pieces of wood in adjacent layers are *staggered*—that is, they are not even with one another. Plywood is produced by assembling *veneers* (thin sheets of wood) with the grains of adjacent layers at right angles to one another. Rearrangement of grain orientation before lamination gives plywood more uniform strength and better dimensional stability than the wood from which it is made.

See also **Plastics** (Making plastic products); **Plywood.**

J. Allan Cash Photography

Lambeth Palace stands at the end of Lambeth Bridge, London. It was first known as Lambeth House.



WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

The lammergeier, a large vulture with distinctive light and dark colouring, has a "beard" of black feathers under its bill.

Lammergeier is one of the largest vultures of the mountain regions of Africa, Asia, and Europe. It measures from 94 to 117 centimetres long and has a wingspan between 2.7 and 3 metres. The lammergeier feeds on wounded, sick, or dead animals. It often breaks open bones by dropping them on rocks from the air. The lammergeier's wings are dark with white streaks. The bird is also called the *bearded vulture* because of its black "beard," which contrasts with its orange neck and breast.

Scientific classification. The lammergeier is in the family Accipitridae. It is *Gypaetus barbatus.*

Lamming, George (Eric) (1927-), is a leading Barbadian novelist. His writing deals with the Caribbean identity and the influence of history on contemporary culture. His novels are largely semi-autobiographical.

His novels include *In the Castle of My Skin* (1953), *The Emigrants* (1954), *Of Age and Innocence* (1958), *Season of Adventure* (1960), *Water With Berries* (1972), and *Natives of My Person* (1972). He published his autobiography, *Pleasures of Exile* in 1960. In his books, Lamming explores the African roots of Caribbean culture, as well as the influence of British colonization. A frequent theme is the experience of exile.

Lamming was born in Carrington Village, Barbados. From 1946 to 1950, he worked as a teacher in Trinidad. He went to live in England in 1950. He taught at universities in Australia, Denmark, Jamaica, Tanzania, and the United States.

LaMoore, Louis Dearborn. See L'Amour, Louis.

L'Amour, Louis (1908-1988), was a popular American author known for his exciting novels about Western frontier life in America. L'Amour's stories have been praised for their historical accuracy and detailed descriptions of Western wildlife and geography. He is also known for his sensitive portrayals of American Indians and Mexicans. A number of L'Amour's novels place a high value on family ties. Many of these stories feature three fictional families named Sackett, Talon, and Chantry.

Louis Dearborn L'Amour (originally spelled LaMoore) was born in Jamestown, North Dakota. He left home as a teenager and wandered for many years throughout the American West, working at a variety of jobs. Encouraged by friends, he began to write down stories he had heard from his grandfather about Indian fighting and the Civil War. L'Amour's first novel, *Westward the Tide* (1950), was followed by the popular *Hondo* in 1953. His other novels include *The Daybreakers* (1960), which introduced the Sackett family; *Bendigo Shafter* (1979); *The Lonesome Gods* (1983); and *The Haunted Mesa* (1987). Many of L'Amour's stories have been made into films and television dramas.

Lamp is a device made to produce light. It ranks as one of the most important inventions. Since the invention of the lamp thousands of years ago, people have not had to depend entirely on the sun for light. Lamps enable people to work and to take part in countless other activities by artificial light.

Through the centuries, people have made many kinds of lamps. But all of them have been one of three basic types: (1) fat or oil, (2) gas, or (3) electric. Today, people use electric lamps almost entirely. Some people keep other kinds of lamps in their houses in case electricity is not available.

Fat or oil lamps produce light by burning fat, grease, oil, or wax as fuel. These lamps have a wick that performs two functions. The wick serves as a place for the flame to form, and it draws the fuel up to the flame by *capillary* action (see **Capillarity**).

The first lamps were fat lamps, which prehistoric people made from sea shells or hollowed-out stones. They used pieces of grasslike plants called *rushes* as wicks and burned animal fat as fuel in these lamps.

The ancient Egyptians also made stone lamps. But the Egyptian lamps burned oil and had cotton wicks. The ancient Greeks and Romans made lamps from bronze or pottery. Early Greek lamps looked like saucers and burned olive oil or the oil of other plants. The wick simply floated on the oil. Later Greek lamps had a groove at the edge of the saucer to hold the wick. Some Roman lamps resembled a teapot. The body of the "pot" held the oil, and the "spout" held the wick.

Candles are a type of fat lamp. The earliest candles were made by coating a wick with wax and pitch. Later, candlemakers used *tallow,* a waxy substance obtained from animal fat. The best candles consisted of beeswax or *paraffin,* a wax obtained from petroleum. Most candles cost more than other types of lamps. Inexpensive lamps called *rushlights* burned like candles. They were made by dipping dried rushes into animal fat. See **Candle.**

A type of oil lamp called a *cruise* appeared in Scotland during the Middle Ages. This lamp consisted of an iron pan that had a trough sticking out from it. The trough held the wick. Many cruises had a second trough beneath the first to catch any oil that dripped from the wick.

Through the years, people added reflectors to lamps to *diffuse* (spread out) or concentrate the light. Otherwise, few improvements occurred in lamps until the late 1700's.

In the 1780's, a Swiss chemist named Aimé Argand invented a lamp in which the wick was bent into the shape of a hollow cylinder. Such a wick allowed air to reach the centre of the flame. As a result, the Argand lamp produced a brighter light than other lamps did. Later, one of Argand's assistants made another improvement after discovering that a flame burns better inside a glass tube.

This later discovery led to the invention of the *lamp chimney,* a clear glass tube that surrounds the flame to block draughts. During this period, whale oil and *colza oil,* an oil from the rape plant, became important fuels for lamps. The birth of the oil industry in the mid-1800's led to the widespread use of paraffin, a petroleum product, as lamp fuel.

Gas lamps produce light by means of one or more small gas flames. These lamps need no wick. The gas flows from the lamp through a small opening and then burns after mixing with air. Gas lamps burn many kinds of gas, including acetylene, butane, coal gas, natural gas, producer gas, and water gas.

William Murdock, a Scottish engineer, developed the first commercially important gas lamps. In 1792, Murdock lit his home with gas lamps that burned coal gas. By the early 1800's, gas lamps had come into use as street lamps in London and other cities. Gas lamps

A paraffin lantern gives campers a bright, portable light. Such fuel-burning lamps provide light in places that have no electricity, or during periods of electric power failure.

served as important sources of light until the late 1800's, when electric lamps began to replace them.

The gas lamp had one chief problem, the open gas flame. The flame often flickered and produced uneven light. Some gas lamps had a glass chimney to help control the flickering. In the late 1800's, a device called a *mantle* solved the problem. A mantle is a loosely woven cloth bag that is soaked with a chemical substance. The cloth quickly burns away in the lamp, and the chemical glows steadily as the gas burns around it. Most modern gas lamps, including the portable gas and liquid fuel lamps used by campers, have mantles.

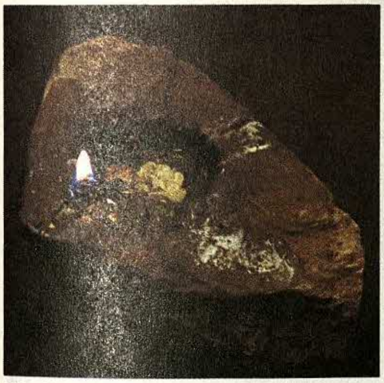
Electric lamps produce light by means of electric energy. The American inventor Thomas A. Edison developed the first practical electric lamp in 1879. Electric lamps came into widespread use in the early 1900's and have replaced other types of lamps for almost every purpose. Electric lamps produce more and better light than the earlier lamps. They are also less expensive and easier to use. For information on electric lamps, see the articles on **Electric light** and **Lighting.**

See also **Invention** (Inventions that give people light); **Lighting** (Lighting problems; Lighting devices).

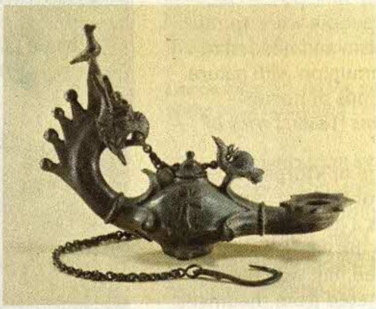
Lampblack. See **Carbon.**

Lamps through the ages

Throughout history, people have used many kinds of lamps. Until electric lights were developed in the late 1800's, all lamps produced light by burning fuels, such as fat, gas, or oil. The most important types of fuel-burning lamps are shown below.

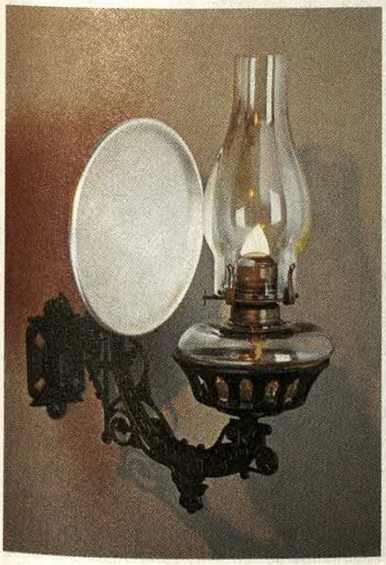


A hollowed-out stone was one of the first lamps. Ancient peoples used plant fibres as a wick to burn fat placed in the hollow.

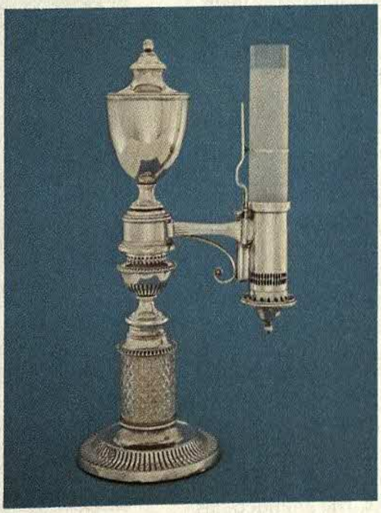


A Roman lamp made of bronze, *above,* burned oil in its spout. This lamp could stand on a table or be hung by a chain.

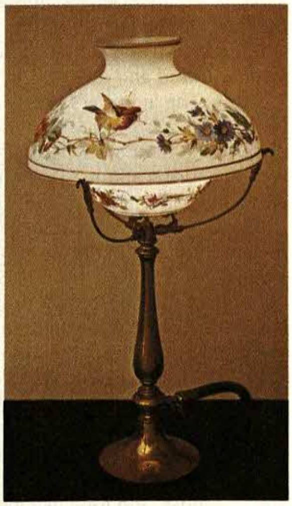
A candle, *right,* is an improved type of fat lamp. Candles once cost so much that only wealthy people could afford to use them.



The paraffin lamp, *above,* has a reflector to redirect the glow and provide as much light as possible.



The Argand lamp was invented in the 1780's. It had a hollow wick so that more air reached the flame, making a brighter light.



The gas lamp lit streets and homes. The above lamp has a glass shade that softens its light.

Lampedusa, Giuseppe Tomasi di (1896-1957), was an Italian prince and author. His novel *The Leopard,* set in 19th century Sicily, was published after his death.

Born in Palermo with the title of Prince of Lampedusa, he served in World War I and later travelled widely. In World War II, Lampedusa saw action with the Italian artillery. After 1945, he began writing prose. In 1955, he started *The Leopard,* which portrays the violent traditions of Sicilian nobility. Its publication in 1958 was followed by *Two Stories* and a *Memory* in 1961.

Lampman, Archibald (1861-1899), was one of the leading Canadian poets of the late 1800's. Lampman's importance lies in his effort to capture a uniquely Canadian landscape in his poetry. He saw such works as the contribution he could make to the development of a distinctly Canadian literature.

Lampman's poetry reflects the influence of William Wordsworth and other English romantic poets. Like Wordsworth, Lampman believed people were spiritually exhausted by urban industrialism and needed to renew themselves by solitary communion with nature. Lampman published three collections of poems—*Among the Millet, and Other Poems* (1888), *Lyrics of Earth* (1895), and *Alcyone* (1899).

Lampman was born in the village of Morpeth, Ontario, near Blenheim. He worked for the Canadian Post Office in Ottawa. However, he was a dedicated naturalist and his canoeing expeditions into the wilderness and walks into the countryside provided him with the experience for his poems. Lampman suffered from rheumatic fever as a child, and as an adult his health was poor. He died of heart disease at the age of 38.

Lamprey is a fish with a long eellike body. Scientists consider the lamprey one of the least developed *vertebrates* (animals with backbones). Unlike most other fishes, the lamprey has no bony skeleton. It has a backbonelike *notochord* made of rubbery tissue called *cartilage.* The lamprey has fins on its back but not on its sides. Its round mouth has no jaws but can create strong suction. Adults of some species develop horny teeth. Such an adult attaches itself to other fishes by sucking with its mouth and clamping with its teeth. It feeds on its victims' blood and other body fluids.

Body. The lamprey's skin is smooth, shiny, and scaleless. *Brook lampreys,* which live in small streams throughout temperate parts of Europe, Asia, and North America, grow about 20 centimetres long. Larger *species* (kinds) live in rivers and lakes.

Sea lampreys, which may grow as much as 90 centimetres long, live in the North Atlantic and North Pacific oceans. All lampreys are dull coloured, ranging from light-tan to mottled-brown or bluish-black. They do not have true bony teeth. Their teeth are horny developments that grow from the inner surface of the mouth.

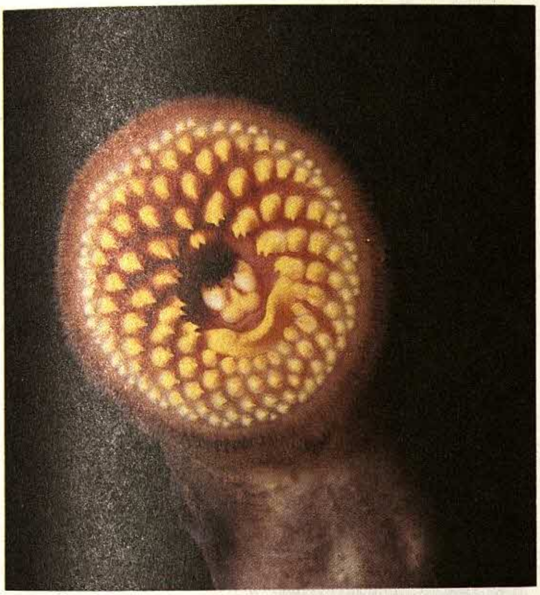
Habits. Lampreys spawn in clear, freshwater streams. The male and female dig a shallow nest in the gravel or pebbles of the stream bottom. The female deposits the eggs in the nest. The adults die after spawning. *Larval* (young) lampreys are called *ammocoetes.* They are blind and toothless, and look like worms. The ammocoetes live in the sand and mud of the stream bottom for several years. Then they change into adults, with eyes and teeth.

Parasitic lampreys feed by attaching themselves to fishes, scraping a hole through the skin, and sucking out blood and other body fluids. The adults of the *nonparasitic* lampreys do not eat. Their digestive organs degenerate, and they live only until the spawning season. Then they spawn and die.

Destructiveness. Large sea lampreys rank as the most destructive to fishes. As adults, they descend to the sea and prey on large fishes. But some sea lampreys once entered the upper Great Lakes of North America through the Welland Canal. Later generations of these lampreys no longer descend to the sea, but prey on lake trout, whitefish, and other large lake fishes. By the late 1950's, they had killed most of the lake trout in the Great Lakes.

Scientists tried to control these lampreys by putting electric *weirs* (fences) across streams to prevent the lampreys from spawning. But the weirs were costly and difficult to maintain. Researchers discovered that a chemical called TFM would kill lampreys but would not harm other fish in the rivers. The treatment of streams with

The lamprey attaches itself to a fish and sucks out blood and other body fluids. The small brook lamprey, *above,* lives in streams in Asia, Europe, and North America.



The lamprey's mouth, *above,* is especially suited for sucking fluids from the bodies of other fish. Horny teeth on the inside of the mouth help the lamprey attach itself to a victim. Similar teeth on the lamprey's tongue rip open the skin of its victim.

this chemical caused a sharp decline in the number of lampreys by the mid-1960's.

Scientific classification. Lampreys belong to the lamprey family, Petromyzontidae. The lamprey found around the coasts of the North Atlantic is *Petromyzon marinus.*

See also **Hagfish.**

Lan-chou. See **Lanzhou.**

Lanai. See **Hawaii (The islands).**

Lanark. See **Clydesdale.**

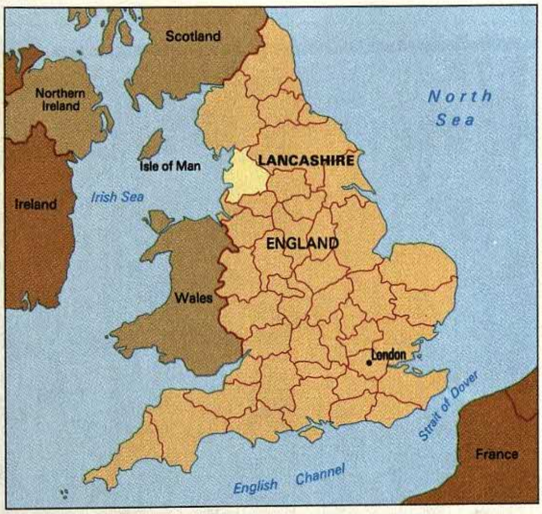
Lanarkshire. See **Strathclyde Region.**

Lancashire is a county on the northwestern coast of England. Its people, called *Lancastrians,* live mainly in manufacturing towns such as Blackburn, Burnley, and Accrington, or in the busy seaside resorts of Blackpool and Morecambe. Other large towns are Preston and Lancaster. Preston is an industrial and administrative centre. Lancaster is the traditional *county town,* because it was for centuries the home of the lords of Lancaster who once ruled the county. In the western parts of the county, many Lancastrians live in small but prosperous agricultural villages.

Lancashire was Britain's largest county in population until 1974. It had more than 5 million people. But in the 1974 reorganization of England's local government, most of this population was taken into other counties. In the north, an area including Barrow-in-Furness was taken from Lancashire into Cumbria. Much of southeastern Lancashire, including the towns of Bolton, Salford, and Manchester, was taken into the new metropolitan county of Greater Manchester. Towns that were formerly in southwestern Lancashire, such as Bootle, Liverpool, and St. Helens, became part of the new metropolitan county of Merseyside. An area including the towns of Warrington and Widnes was taken from Lancashire into Cheshire. All these changes reduced the population of the county to about a quarter of its former size. But still Lancashire is one of the largest English counties in terms of population.

Facts in brief about Lancashire

Administrative centre: Preston.
Largest towns: Blackpool, Blackburn, Preston, Burnley, Lancaster.
Area: 3,045 km².
Population: *1991 census*—1,365,100.
Chief products: Aircraft engineering, coal, eggs, electrical engineering, fish, floor coverings, flour, furniture, limestone, milk, plastics goods, textiles, vegetables.



Lancashire lies on the northwestern coast of England. It is one of the most populated English counties.

People and government

Local customs and legends. There are a few local stories about boggarts, goblins, and other fairy creatures. But little ancient folklore remains.

Local traditional activities include Sunday-school outings, choir trips, brass band contests, and day excursions to the coast. The old textile towns of Lancashire still observe *wakes* (holiday weeks) when most local workers take holidays at the same time.

Recreation. Association football draws large crowds throughout Lancashire. Towns with teams in the Football League are Blackburn, Blackpool, Burnley, and Preston. There are also many amateur football teams in Lancashire.

Cricket is popular and Lancashire has a team in the first class county championship, while league cricket is popular in the eastern part of the county. Rugby and golf have many supporters. Lytham St. Anne's has golf courses over which major British golf events, including Ryder Cup matches and the British Open Championship, have been played. Sports, such as fishing, bowling, darts, and snooker, are usually based on local public houses or working-men's clubs. The Derby Bath at

Preston Riversway, a development on the site of the town's docklands, has a marina and other facilities for recreation and entertainment.

Blackpool is equipped to Olympic standards and is a frequent venue for international swimming and diving events.

Blackpool claims to be the largest holiday resort in the United Kingdom. Its attractions include an 11-kilometre promenade and safe sandy beaches overlooked by an iron tower 158 metres high. The resort also features a fun park and an international circus.

Local government. Lancashire is divided into 14 local government districts: *Blackburn; Blackpool; Burnley; Chorley; Fylde,* which includes Lytham St. Anne's; *Hyndburn,* which includes Accrington; *Lancaster; Pendle,* which includes Nelson; *Preston; Ribble Valley,* which includes Clitheroe; *Rossendale,* which includes Bacup; *South Ribble,* which includes Leyland; *West Lancashire,* which includes Ormskirk; and *Wyre,* which includes Fleetwood. Lancashire County Council, which has headquarters at Preston, provides some public services throughout the county.

Skelmersdale, in southern Lancashire, is a *new town.* It is designed to grow rapidly, attracting new industries and new residents.

The crown court meets at Preston. The county's police force is the Lancashire Constabulary, which has headquarters at Hutton.

Economy

Manufacturing. At one time, cotton manufacture dominated Lancashire's economy. But since the 1920's, the textile industry has decreased in size. It now uses as much artificial fibre as cotton. Many former cotton mills, in towns such as Blackburn, Burnley, and Nelson, have been adapted for other industries. Some are used for making clothes, light engineering goods, or plastics goods.

Preston's main industries are aircraft engineering and electrical engineering. Leyland is mainly a centre for producing commercial vehicles. Lancaster has flour-milling and milk-processing industries, and produces floor coverings and furniture. A wide variety of light industries have transferred to the new town of Skelmersdale.

British Nuclear Fuels have an establishment at Salwick, near Lytham St. Anne's, which makes fuel elements for nuclear reactors. On the same site is a nuclear research and development laboratory.

Agriculture. In western Lancashire, agriculture is the most important industry. South of the River Ribble, in the Ormskirk area, most of the agricultural land is used for crops. Crops include root vegetables, cabbages, peas, and beans, which are grown for the local markets or for freezing and canning. Market gardeners produce lettuce, tomatoes, and cucumbers for sale in the local markets.

North of the River Ribble, in the Fylde area, most of the farmland is used as pasture, mainly for dairy cattle. Farmers supply the nearby towns with milk and eggs.

Fishing. Fleetwood is one of the United Kingdom's major fishing ports. Its trawlers, which fish in the waters of the Arctic Ocean, supply fish for a great part of north-western England.

Mining and quarrying. Coal mining is a dying industry. Coal was first mined near Burnley in the 1200's, and in the Wigan area in the 1500's. But now little coal is mined within the county. Quarries in the Carnforth area produce much limestone.

Transportation and communication. The electrified railway from London to Glasgow runs northwards through the middle of Lancashire. Parallel to it is the M6 motorway. Other railways, and roads such as the M61, feed into these two main routes. The M55 connects Blackpool and the Fylde area with the M6.

Blackpool airport provides services to other parts of the United Kingdom and some cities in continental Europe. But many passengers from Lancashire use one of the bigger airports just outside the county—Manchester International or Speke, near Liverpool.

Lancastrians have good local publications and other communications. Daily newspapers are published for Blackburn and Burnley, Blackpool, and Preston. In southern Lancashire, the *Liverpool Echo* and *Manchester Evening News* are popular. All the main towns have weekly newspapers. BBC Radio Lancashire is based in Blackburn. Red Rose Radio, an independent station, broadcasts to the area round Blackpool and Preston.

Tourism. The coastal towns of Blackpool, Morecambe, and Fleetwood attract large crowds of holidaymakers. The Pennine Hills, Lune Valley, and the Forest of Bowland attract many walkers. An increasing number of people hire boats to go cruising on Lancashire canals during the holiday season.

Land

Location and size. To the north Lancashire is bounded by Cumbria, to the east by North Yorkshire and West Yorkshire, and to the south by Greater Manchester and Merseyside. Lancashire's western coast borders the Irish Sea. The county's maximum dimensions are 77 kilometres from north to south and 64 kilometres from east to west.

Land features. The fertile coastal plain of Lancashire contains large stretches of reclaimed marshland. For example, the areas north and south of the Ribble estuary were drained in the 1700's. The coastal plain is about 24 kilometres wide in the central part of Lancashire.

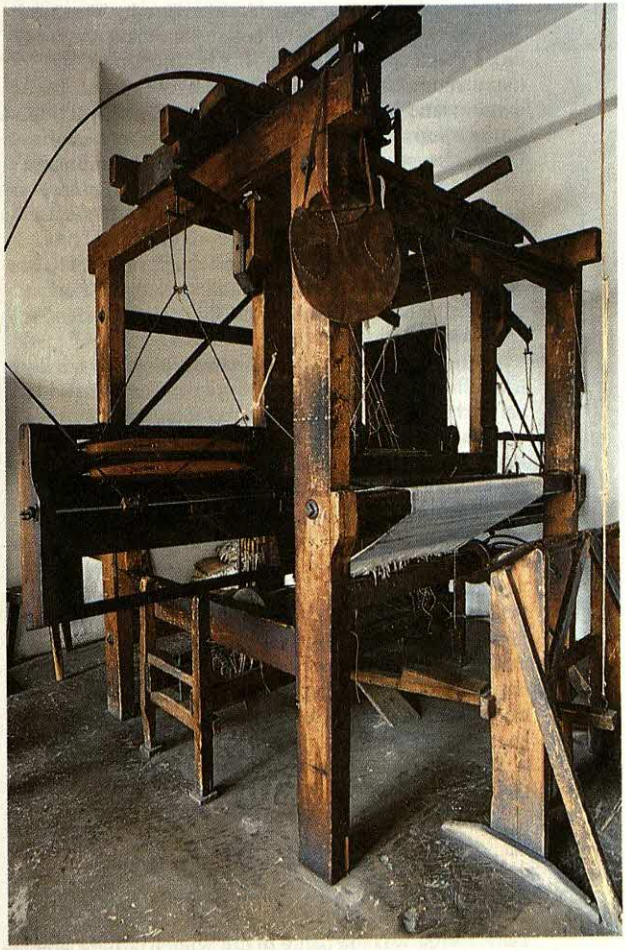
All of eastern Lancashire is hilly. The highest mountain in Bowland Forest is Ward Stone, which reaches 560 metres. Ward Stone lies only 16 kilometres from the coast. Pendle, a mountain 558 metres high, dominates the country east of Clitheroe.

Rivers. Lancashire's rivers flow from the eastern mountains into the Irish Sea. The Lune enters Lancashire from Cumbria and enters the sea southwest of Lancaster. The Wyre rushes down from Bowland Forest and flows through Garstang, Poulton, and Fleetwood. The Ribble, Lancashire's biggest river, rises in the Pennines and enters the county from North Yorkshire. It crosses Lancashire in a southwesterly direction, passing through Preston and flowing into the Irish Sea.

Lancashire has no natural lakes. But several Pennine streams have been dammed to create reservoirs.

Climate. The Irish Sea has a moderating effect on Lancashire's climate. Snow seldom lies for long in the county, and summer heat waves are rare.

Average temperatures are about 2° C in mid-winter and 19° C in midsummer. Western Lancashire has an average annual rainfall of about 890 millimetres. In northern and eastern Lancashire, the average rainfall is more than 1,020 millimetres.



The Lewis Textile Museum displays many items relating to the history of textiles, including this flying shuttle loom of the 1700's. Textiles have been an important industry in Lancashire for more than 200 years.

History

In Roman times, Lancashire was sparsely populated. The area's only interest to the Romans was as a route from *Deva* (Chester) to Hadrian's Wall. Anglo-Saxons colonized the Lancashire area late in their settlement of Britain. During the 900's, many Vikings invaded from the Irish Sea and settled on Lancashire's coastal plain.

When William I of Normandy conquered England, he entrusted Lancashire to Roger of Poitou. Roger built a castle at Lancaster and endowed Lancaster Priory, the county's first monastery.

In 1351, King Edward III made Lancashire a *palatinate,* giving royal privileges and power to its ruler, as a reward to Henry, First Duke of Lancaster, for outstanding service in the Hundred Years' War. In 1399, Henry, Third Duke of Lancaster, became King Henry IV. He maintained the Duchy and the Palatinate as separate administrative units. Even today, people within the county still toast the monarch as *Duke of Lancaster.*

During the 1500's, Lancashire's prosperity increased. The new wealth came from cottage spinning and weaving, surface coal mining, improved agriculture, and manufacture of iron goods on small forges. Families owning land built new homes, many of which still stand. But religious strife limited the prosperity. In western Lancashire, many families defied the Reformation and persisted in Roman Catholicism. In the east, Puritanism flourished. During the Civil War of the mid-1600's, Lancastrians were divided in their loyalties.

Roman Catholicism maintained much strength in Lancashire. But Lancastrians gave little help to the Roman Catholic Jacobite rising of 1715. This rising received a crushing defeat at Preston.

By the mid-1700's, industry was developing steadily in Lancashire. There was a growing overseas demand for Lancashire goods, especially textiles and metal goods.

New inventions increased production greatly. James Hargreaves, of Oswaldtwistle, invented the *spinning jenny.* Sir Richard Arkwright, of Preston, invented the *water frame.* As industry expanded, families left their village homes and crowded into hastily built towns to work in factories.

Famous people associated with Lancashire include William Cardinal Allen, who was born at Rossall. Sir James Kay-Shuttleworth lived at Gawthorpe Hall, near Burnley. He laid the foundation for state education in England and Wales. But Lancashire's most characteristic personalities were factory owners and inventors, such as Arkwright and Hargreaves.

Related articles in ***World Book*** include:

Allen, William Cardinal
Arkwright, Sir Richard
Blackburn
Blackpool
Burnley
Hundred Years' War
Industrial Revolution
Jacobite risings
Kay-Shuttleworth
Pennine Hills
Preston
Puritans
Reformation

Lancaster was the name of the branch of the Plantagenet royal family that ruled England from 1399 to 1461. The House of Lancaster also ruled for a short time in 1470 and 1471.

John of Gaunt, 4th son of Edward III, founded the dynasty when he became Duke of Lancaster through his marriage to Blanche of Lancaster. The House of York stemmed from Gaunt's brother Edmund. Gaunt's son became Henry IV in 1399, taking the throne away from his childless cousin, Richard II. This act led to the Wars of the Roses between the House of Lancaster and the House of York, which broke out over 50 years later.

Henry IV's eldest son succeeded him as Henry V. Through his conquests in France, Henry V became one of the most famous warrior kings of England. In William Shakespeare's play *Henry IV,* he is identified as Prince Hal. Henry V died in 1422, leaving the throne to his baby son, Henry VI. All that his father won, the kindly but weak-minded Henry VI lost. The House of York defeated Henry VI in battle in 1461 and put Edward IV on the throne.

Henry regained the throne for a few months in 1470-1471, but lost it when he was imprisoned in the Tower of London. He was murdered a few days later, and the direct line of the House of Lancaster came to an end.

See also **Henry** (IV, of England); **John of Gaunt; Wars of the Roses.**

Lancaster (pop. 125,600) is a city and local government district in north Lancashire, England. The old city of Lancaster, the county town of Lancashire, stands on the River Lune, about 80 kilometres north of Liverpool. It has a Norman castle founded by William I. Much of it has been rebuilt. St. Mary's Church has some superb examples of fine woodwork, including 14 decorated stalls that date from the end of the 1300's. The Roman Catholic Cathedral of St. Peter was erected in 1859. The Storey Institute includes an art gallery. Lancaster also has a university on a specially built campus to the south of the city. Lancaster's chief industries produce furniture, plastics, and rayon and other textiles.

The district of Lancaster includes the towns of Morecambe, Heysham, and Carnforth, and many areas of outstanding beauty, particularly around Silverdale in the Lune valley and on the moorlands. Morecambe is a seaside resort. The Central Electricity Generating Board has a nuclear power station at Heysham.

See also **Lancashire.**

Lancaster, Duchy of, is a group of estates belonging to the reigning British monarch, who personally receives its revenues. It includes Lancashire, the County Palatine of Lancaster. The duchy is an independent administrative unit headed by a chancellor. The chancellor appoints county court judges and justices of the peace for Lancashire. The lord chancellor appoints them for the rest of Britain. The chancellor of the Duchy of Lancaster is a member of the government and performs various ministerial duties. The duchy was created in 1265 and has belonged to the monarch since 1399.

Lancaster, Joseph (1778-1838), developed the monitorial system of teaching advocated by Andrew Bell, superintendent of an orphanage in Madras, India, in the 1790's. In 1801, Lancaster opened a school in London, where he put his theories into practice, allowing the more able pupils to conduct classes. Later, he came into conflict with the Church of England because, being a Quaker, he did not teach the catechism. Lancaster was born at Southwark, in southeast London.

Lancaster, Sir Osbert (1908-1986), an artist and author, won fame with his humorous cartoons for the British newspaper the *Daily Express.* His best-known creation was the Littlehampton family, a brilliant parody of the English upper classes. Lancaster's many books, which consisted mainly of humorous and satirical drawings, include *Progress at Pelvis Bay* (1936), *Homes, Sweet Homes* (1939), *Drayneflete Revealed* (1949), and *The Littlehampton Bequest* (1973).

Lancaster was born in London and educated at Charterhouse School, Oxford University, and the Slade School of Art. He trained as a stage designer. In 1939, Lancaster became a regular cartoonist with the *Daily Express.* He also helped to edit the *Architectural Review.* For many years, Lancaster was adviser to the Greater London Council on historic buildings. He was knighted in 1975.

Lance. See **Fireworks** (How fireworks work).

Lance. See **Spear.**

Lancelet. See **Amphioxus.**

Lancelot, Sir, was one of the knights in medieval legends of King Arthur's Round Table. Lancelot won fame for his bravery and skill in combat, and he became Arthur's favourite knight. But Lancelot had a love affair with Queen Guenevere, Arthur's wife, that led to his downfall. The scandal that resulted from their affair contributed to the breakup of the Round Table. See **Round Table.**

Lancelot was the son of Ban, the king of Brittany. The Lady of the Lake, a woman with magic powers, took Lancelot as an infant to her castle at the bottom of a lake. After he reached manhood, the Lady of the Lake brought him to Arthur's court. Lancelot had a brief affair with Elaine of Astolat, a British princess. They had an illegitimate son, Galahad, who became a famous knight of the Round Table.

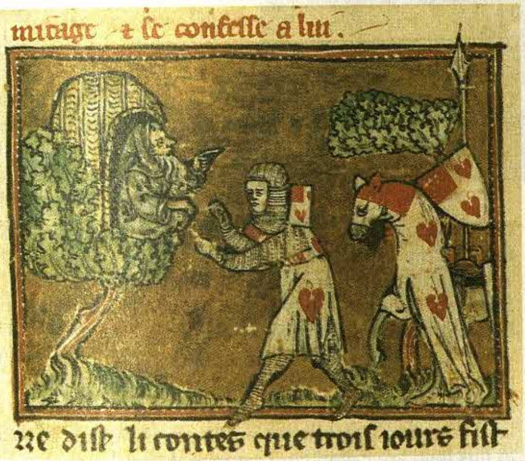

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Illustration (about 1300) from a French manuscript; Bodleian Library, Oxford, England

Sir Lancelot was a member of King Arthur's legendary Round Table. During his quest for the Holy Grail, Lancelot met a hermit living in a hut in a tree, *above.*

Along with many other knights, Lancelot went on the search for the *Holy Grail,* the cup or dish that Jesus Christ used at the Last Supper. Because he was morally imperfect, Lancelot did not find the Holy Grail. But his son, Sir Galahad, did find it.

Lancelot and Guenevere had fallen in love at Arthur's court. After Arthur discovered their affair, the lovers fled to Lancelot's castle, Joyous Garde. Lancelot killed several of his fellow knights after they found him with the queen. Later, Lancelot returned Guenevere to Arthur and left Britain. Arthur pursued Lancelot to France but went back to Britain after learning that Modred had seized his kingdom. According to various accounts, Modred was either Arthur's nephew or his son. Lancelot returned to Britain after Arthur's death and learned that Guenevere had become a nun. He became a priest and died shortly after Guenevere did.

Lancelot first appeared as an important character in a French story written about A.D. 1180 by Chrétien de Troyes. Sir Thomas Malory, an English writer, gave the fullest account of Lancelot in English in *Le Morte Darthur* (about 1469). Lancelot was also a character in a series of poems by the English poet Lord Tennyson.

Lancewood is a tough wood used for archery bows, fishing rods, tool handles, and objects made on a lathe. It comes from two types of trees that grow in tropical America. Lancewood is yellowish brown, finely textured, and quite heavy.

Scientific classification. The two species of lancewood are *Oxandra lanceolata,* family Annonaceae, and *Calcycophyllum candidissum,* family Rubiaceae.

Land. See **Earth** (The earth's surface); **Soil.**

Land, Edwin Herbert (1909-1991), an American inventor, scientist, and business executive, invented the Polaroid Land camera, the first instant camera. Instant cameras produce a photograph seconds after the photographer takes a picture.

Land held more than 500 patents. In 1934, he patented *polarized light filters,* which help eliminate glare and reflections on glass and other surfaces. In 1937, Land founded the Polaroid Corporation to manufacture the filters. He became its president and chairman of the board. Land developed light filters.

In 1947, Land demonstrated the first instant cameras. These cameras took only black-and-white pictures, which developed in about a minute. In 1963, Land introduced a colour film that developed into photographs inside the camera within 50 seconds. By 1972, Land had improved this system to take colour pictures that developed outside the camera.

Land was born in Bridgeport, Connecticut. He attended Harvard University, though he never graduated. He retired as president of Polaroid in 1975 and as chairman of the board in 1982.

See also **Photography** (Instant processing); **Polarized light** (Polarizing materials).

Landing craft. See **Amphibious ship; Warship** (Amphibious warfare ships).

Landlord. See **Tenant; Lease.**

Landor, Walter Savage (1775-1864), an English poet, essayist, and novelist, was noted for his graceful but forceful style. His best-known work, *Imaginary Conversations* (1824-1829), consists of fanciful philosophical discussions between great historic figures of the past. Landor's other works include *Gebir* (1798), *Count Julian* (1812), *Idyllia Heroica* (1814), *Pericles and Aspasia* (1836), *Hellenics* (1847), *Last Fruit off an Old Tree* (1853), *Dry Sticks Fagoted by W. S. Landor* (1858), and *Heroic Idylls* (1863).

Landor was born at Warwick, England, and studied at Oxford University. In his later years, he spent much of his time in Italy.

Landowska, Wanda (1879-1959), was a Polish pianist, composer, and harpsichordist. She helped revive interest in harpsichord music in the 1900's.

Landowska was born in Warsaw. She moved to Paris in 1900, where she researched the musical performance practices of the 1600's and 1700's. Landowska became convinced that the harpsichord was the appropriate instrument for music of this period and she developed modern harpsichord technique.

In the years following her Parisian debut in 1903, Landowska toured internationally, playing both the piano and harpischord in concerts. In 1923, she made her first visit to the United States, performing as a harpsichord soloist with the Philadelphia Orchestra. In the 1920's and 1930's, she operated a school near Paris dedicated to the study of early music. She left in 1940 to settle in the United States. When she was 70 years old, Landowska recorded the complete *Well-Tempered Clavier* by Johann Sebastian Bach. Her many writings include the book *Music of the Past* (1909).

Land's End juts into the English Channel. Its granite cliffs have been battered into strange shapes by the persistent action of the sea.

Land's End, a cape in the English county of Cornwall, is the most westerly point of the mainland of England. It juts into the English Channel where the channel opens into the Atlantic Ocean. For location, see **United Kingdom** (map). Land's End is a granite promontory with cliffs between 18 and 60 metres high, which have been carved into strange shapes by the waves. It is the last part of the mainland seen from ships sailing westwards.

Land's End is privately owned but is open to tourists and visitors. Longships Lighthouse on Carn Bras, a rocky islet about 1.5 kilometres west of Land's End, marks dangerous reefs.

Landsborough, William (1825-1886), an Australian explorer, was appointed head of one of the expeditions organized in 1861 to look for the lost and ill-fated Burke and Wills exploration party. In a journey lasting 16 months, Landsborough travelled from near the Gulf of Carpentaria overland to Melbourne. On the way, he discovered the Gregory and Georgina rivers and the Barkly Tablelands. Landsborough was born in Ayrshire, in Scotland, and settled in Australia as a youth.

Landscape architecture is a profession that involves the design and development of land for human use and enjoyment. It is concerned with the beauty of natural surroundings as well as practical ways to use land and the objects on it. People professionally trained in this field are called *landscape architects.*

Landscape architects create plans for a wide variety of land development projects. These projects may range from national parks to small city squares, or from multifamily housing developments to gardens for single family homes. Landscape architects may create equipment for a playground or propose a master plan for university expansion. They might plan the layout of a golf course

Landscaped gardens are among the many different projects undertaken by landscape architects. This well-planned municipal garden, *left,* contrasts with the natural surroundings.

or for an entire new community. They are involved at all levels at which land use decisions are made, from land planning to site design, to land use management.

Land planning. Landscape architects prepare regional land use reports. These reports include environmental impact statements, which evaluate what land is best suited for residential, industrial, transportation, recreation, and conservation purposes. They study such area features as climate, water supply, vegetation, soil composition, and the slope of the land. They attempt to preserve attractive views and historic landmarks, and to avoid erosion, flooding, and air and water pollution. Landscape architects often work with traffic engineers, ecologists, city planners, and public officials.

Site design. After land use has been determined, landscape architects prepare site development plans and supervise construction contractors. They work with architects to fit structures to land forms, making best use of breezes, sunlight, and views. In designing roads, parks, and other sites, they may decide to keep mature trees for shade and arrange for proper grading and drainage. They design walls, fences, steps, pavement patterns, and planting arrangements.

Landscape architects try to arrange outdoor facilities so the facilities function smoothly and harmonize with the surroundings. A city square, for example, may have sitting places, fountains, and ornamental plants designed to fit well into traffic and building patterns.

Land use management. Landscape architects help park superintendents and other land administrators develop procedures for using land in a way that conserves its productivity and beauty. For example, a landscape architect might prepare a resource management programme for forests and waterways.

History. Landscape architecture as a profession dates from the mid-1800's. But as an art, it has been practised for thousands of years. For example, many Roman homes built between the 400's B.C. and the A.D. 400's had elaborate courtyards. Other early examples include the gardens of ancient Persia (A.D. 200's to 600's) and Japan (A.D. 500's). The Italians designed and built beautiful hillside estates and civic squares during the 1400's and 1500's. France in the 1600's and 1700's was noted for its magnificent palaces and city gardens. English designers planned natural-looking country estates in the 1800's.

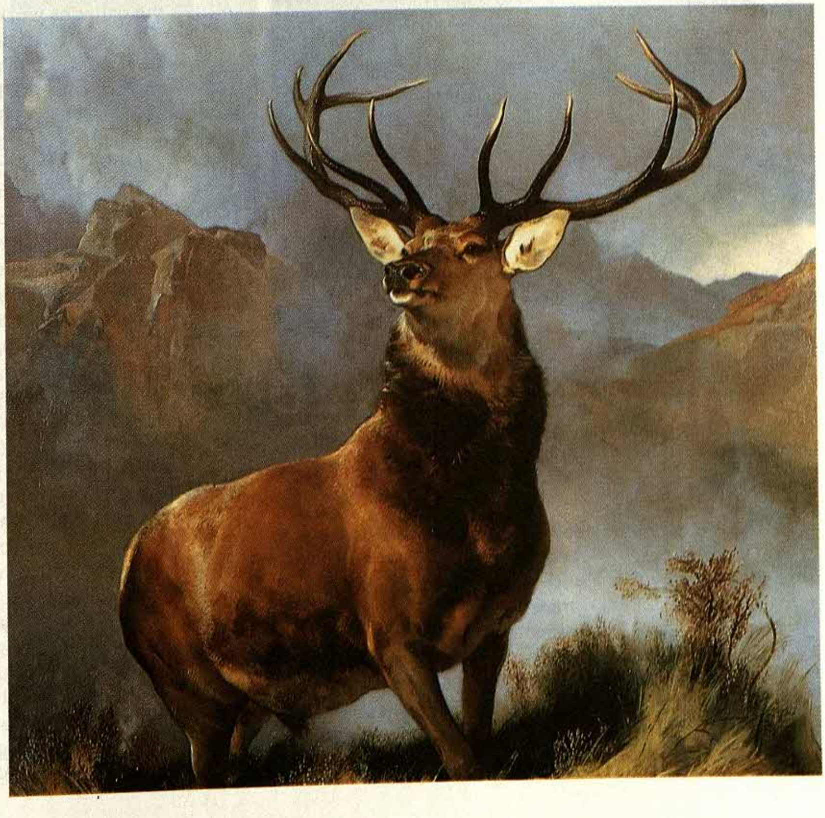
Many of these early projects were gardens and country estates. For this reason, the designers were often called *landscape gardeners.* Frederick Law Olmsted, an American, was the first person to call himself a landscape architect. In the 1770's, Lancelot Brown, known as "Capability" Brown, laid out the gardens at Kew and Blenheim Palace in England. He is generally regarded as one of the great landscape architects of all time.

Related articles in ***World Book*** include:

Botanical garden
Brown, Capability
Fountain
Kent, William
Le Nôtre, André
Olmsted, Frederick Law
Paris (picture)
Park
Town planning
Versailles

Landscape painting. See **Painting** (What do painters paint?).

Landseer, Sir Edwin (1802-1873), was a British artist who specialized in painting animals. His rather sentimental portrayal of them appealed greatly to the Victori-



Monarch of the Glen, *right,* and Sir Edwin Landseer's other paintings of animals, are considered sentimental by many people today. But they were immensely popular when they were painted in Victorian times.

Sir Edwin Landseer

ans. His favourite subjects were dogs and deer. Many of his paintings, such as *Monarch of the Glen* (1851), are set in the Scottish Highlands. His other work includes the design of the lions at the base of Nelson's Column in Trafalgar Square, in London. He also painted portraits. His subjects include Queen Victoria and Prince Albert.

Landseer was born in London, the son of an engraver. He began exhibiting at the Royal Academy at the age of 13. He became a Royal Academician in 1830. He was elected president of the Academy in 1866, but declined the position. He was knighted in 1850.

Landslide, in geology, is a mass of earth or rocks that slides down a slope. Two conditions are necessary for a landslide: a steep slope and a weakness in the solid rock beneath the surface of the slope. Earthquakes or heavy rains can trigger landslides. Erosion caused by rivers, waves, glaciers, or construction projects creates the steep slopes necessary for landslides.

Landslides are triggered by soil erosion after heavy rainfall or by vibrations such as traffic or earthquakes.

Landsteiner, Karl (1868-1943), won the 1930 Nobel Prize for physiology or medicine for his discovery of the main types of human blood—A, B, AB, and O. This discovery made safe blood transfusions possible for the first time. In 1940, Landsteiner and his co-workers, Philip Levine and Alexander Wiener, discovered the Rh blood factor, an important cause of stillbirths. Landsteiner also contributed information on how the body becomes immune to certain disease bacteria. His research helped the discovery that a virus causes polio.

Landsteiner was born in Vienna, Austria. He moved to the United States in 1922 and was a member of the Rockefeller Institute for Medical Research (now Rockefeller University) in New York from 1922 to 1939.

See also **Blood** (Blood groups); **Rh factor**.

Landy, John (1930-), an Australian runner, was the second man in the world to run a mile in less than 4 minutes. He performed the feat at Turku, Finland, in June 1954, setting a record time of 3 minutes 58 seconds. The British runner Roger Bannister had run a mile in less than 4 minutes a month earlier (see **Bannister, Sir Roger**). Landy was born in Melbourne.

Lane, Sir Allen (1902-1970), was a publisher and a leader in the paperback revolution in British book publishing. His belief in the public's desire for low-priced quality reading material made the company he founded, Penguin Books, Ltd., one of the most successful publishing organizations in the English-speaking world.

Lane was born Lane Williams at Bristol, southwest England. In 1919, he was apprenticed to the publisher John Lane of The Bodley Head, London. While at The Bodley Head, he changed his name to Allen Lane. In 1936, he resigned to found Penguin Books, which became an immediate success. Lane started other publishing ventures, including the Pelican and Puffin series.

Lane, Sir Hugh (1875-1915), was an Irish art collector and art patron. He was drowned when the *Lusitania* was torpedoed during World War I. Lane intended to leave his collection of 39 French Impressionist paintings to the National Gallery of Ireland. But the document stating this wish was not witnessed and, as a result, was not a valid codicil to his will. For this reason, the National Gallery in London, which held the paintings, retained them. In 1959, the galleries worked out an agreement that enabled them to share the display of the paintings. Lane was born in County Dublin. In 1914, he became director of the National Gallery of Ireland.

Lane, William (1861-1917), an Australian socialist, was one of the leaders of the trade union movement in Australia. In the 1880's, he persuaded trade unions in Queensland to join together to form the Brisbane Trades and Labour Council. Lane also persuaded the trade unions to establish the Australasian Labour Federation with the aim of contesting elections. This was the first form of labour party in Australia.

Lane's efforts had little success. The trade unions lost much of their influence during the depression of the 1890's, and most attempts at strike action failed because the unions were not properly organized. But Lane remained determined to prove that his socialist ideas could work successfully in practice. He organized and led various socialist experiments in Paraguay.

Lane was born in England. He settled in Australia in 1882. From 1883 to 1885, he was labour correspondent for two Brisbane newspapers. In 1887, he founded the socialist weekly paper, *The Boomerang.* In 1899, after several years in Paraguay, he settled in New Zealand.

Lanfranc (1005?-1089) was an important medieval teacher and scholar. He was an adviser to William the Conqueror, the first Norman king of England, and served under him as archbishop of Canterbury.

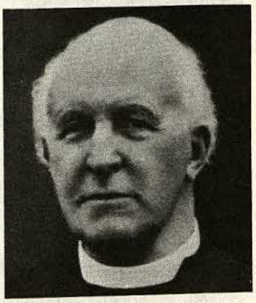
Lanfranc was born in Pavia, Italy. He became a monk in the Benedictine order at Bec, in Normandy, about 1042. Lanfranc was head of the monastery school for about 18 years, and achieved distinction as a teacher of theology. Under his leadership, the school became one of the most famous in Europe. Saint Anselm and the future Pope Alexander II were among Lanfranc's students. Lanfranc also wrote several influential books on monastic life and the sacrament of Communion.

In 1070, William appointed Lanfranc archbishop of Canterbury. As archbishop, Lanfranc reformed the guidelines for the marriage of priests, and set up the church's court system in England.

Lang, Andrew (1844-1912), was a Scottish scholar and author. Lang wrote a large number of works on a wide variety of subjects. He published poetry, fiction, literary criticism, anthropological studies, translations, children's books, histories, and biographies.

Lang's studies of folklore are probably the most enduring of his works. His book *Myth, Ritual, and Religion* (1887) is an important statement of Lang's theories about the relationship between folklore and mythology. Lang worked with other scholars on translations of the Greek epics the *Iliad* and the *Odyssey.* His translations and critical works on ancient Greek writers made a significant contribution to contemporary interpretations of classical literature.

Lang, Cosmo Gordon (1864-1945), was England's archbishop of Canterbury from 1928 to 1942. During this time, he worked to improve conditions in industrial cities and contributed to the movement for Christian unity. He advised the Royal Family and the government during the crisis over the abdication of Edward VIII in 1936, and crowned King George VI in 1937.


Archbishop Lang

Lang was born at Fyvie, in Grampian Region, Scotland, and educated at Glasgow and Oxford universities. He was ordained in the Church of England in 1890. He was appointed canon of St. Paul's and bishop of Stepney in 1901. From 1909 to 1928, he was archbishop of York. In 1942, after he retired, he became Baron Lang of Lambeth.

Lang, Fritz (1890?-1976), was a film director who made classic horror and suspense films in both Germany and the United States. Lang first gained recognition in Germany for his silent films about the corruption of society by criminals and mad scientists. The most important of these movies were *Dr. Mabuse, the Gambler* (1922), *Metropolis* (1926), and *Spies* (1928). Lang's first sound film, *M* (1931), describes the search for an insane killer of children.

Lang fled Germany in 1933 rather than direct films for the Nazis, and he settled in the United States. His best American films all concern a man being pursued by an evil force that drives him to desperation. For example, *Fury* (1936), Lang's first American film, deals with a man threatened by a lynch mob. *The Big Heat* (1953) portrays a man's battle against gangsters. Lang's other American movies include *You Only Live Once* (1937), *The Return of Frank James* (1940), *Man Hunt* (1941), *The Ministry of Fear* (1944), *The Woman in the Window* (1945), and *Rancho Notorious* (1952).

Lang was born in Vienna, Austria. He directed his first film in 1919.

Lang, John Dunmore (1799-1878), the founder of the Presbyterian Church in Australia, also played an active part in that country's political life. He fought to establish better facilities for education, to end the transportation of convicts to the colony, and to encourage the migration of free settlers. His blunt and forceful manner earned him many enemies, but his enthusiasm and energy also contributed greatly to the early development of Australia.

John Dunmore Lang

Lang was born at Greenock, in Scotland. He was educated at Glasgow University. In 1820, Lang became a preacher. He sailed to Sydney in 1822 to join his younger brother, who had emigrated to New South Wales a year earlier. John Lang immediately began to establish the Presbyterian Church in the colony.

In 1831, Lang persuaded the British government to assist 140 Scottish workers and their families in settling in Australia, so that they could help build a Presbyterian school. The scheme was successful, and Lang became a strong advocate for assisted migration from Britain. He made several visits to Britain to encourage free settlers to move to Australia, and urged that money from the sale of Crown lands be used to assist them.

In 1843, the people of the Port Phillip district elected Lang as their representative in the Legislative Council. Lang unsuccessfully led a campaign for the separation of Port Phillip from New South Wales. He led a similar campaign for the separation of Queensland from New South Wales in 1854. He argued that Australia should become independent of Britain, and wrote articles advocating a union of republican states in Australia.

Lang, John Thomas (1876-1975), was premier of New South Wales, Australia, from 1925 to 1927 and from 1930 to 1932. He worked to combat an economic depression during his second term as premier.

In 1929, the financial crisis in the United States led to the collapse of Australia's export trade. People's earnings rapidly decreased, and many factories closed down. By 1932, one out of every three Australians was out of work. Many people lived on state benefits. Lang, as premier of New South Wales, devised the *Lang Plan.* He urged the federal and state governments to suspend interest on British loans and reduce interest on government bonds. But, during a conference in 1930, the

J. T. Lang

state premiers adopted the *Premiers' Plan*, which opposed Lang's plan. The Premiers' Plan involved cutting public servants' salaries and pensions, and raising taxes. The dispute over which plan to adopt caused a split in the governing Labor Party. The New South Wales members of the federal Labor Party voted against the government, and the government fell. Joseph Lyons, leader of the United Australia Party, became prime minister.

Meanwhile, Lang refused to pay interest on government bonds held in New South Wales. Lyons paid the debt to bondholders, then passed a federal act to seize the same amount of money from New South Wales government funds. Lang withdrew state funds from banks and refused to pay the money. Sir Philip Game, the governor of New South Wales, intervened and dismissed him from office. Lang lost the following state election.

Lang was born in Sydney. He first entered the New South Wales parliament in 1913. As premier, he pioneered such social services as widows' pensions and child endowment. His public works schemes included the construction of the Sydney Harbour Bridge. After his dismissal, he remained a member of state parliament until 1946. Lang was a member of the federal Parliament from 1946 to 1949.

Langbaurgh-on-Tees (pop. 141,700) is a local government district in Cleveland, England. It includes part of the North Yorkshire Moors National Park and has three holiday resorts along its coast: Marske, Redcar, and Saltburn. Important industries in the district include steel making, the manufacture of chemicals, and potash mining. Teesport has good port facilities and, inland, the town of Guisborough is a busy market town.

Lange, David Russell (1942-), was prime minister of New Zealand from 1984 until 1989, when he resigned from office. He took office after the Labour Party defeated the governing National Party in the 1984 elections. His party won again in 1987, and Lange remained prime minister. A moderate socialist, Lange favours some government and some private ownership of industries. In foreign policy matters, he supports greater independence from Great Britain and the United States. Under Lange, the government established a policy that excluded from New Zealand ports and territorial waters all ships powered by nuclear fuel or armed with nuclear weapons. These ships include military vessels belonging to the United States. In 1985, a U.S. destroyer was denied access to a New Zealand port after U.S. officials refused to announce whether or not the ship carried nuclear weapons.

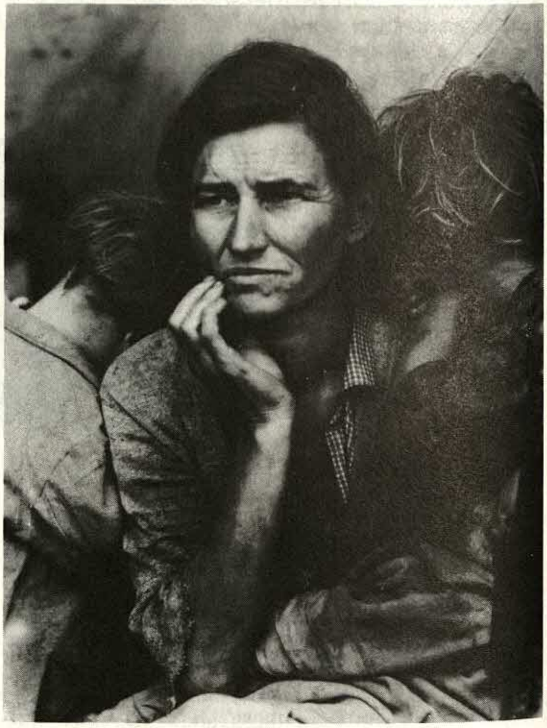
Lange was born in Auckland. He earned law degrees from the University of Auckland in 1966 and 1970. For several years, he worked as a lawyer, often taking the cases of people who could not afford to pay. He first won election to Parliament in 1977. He represents Mangere, a working-class suburb of Auckland. He was the leader of the Labour Party from 1983 until 1989.

David R. Lange

Lange, Dorothea (1895-1965), was an American photographer known for her pictures of migratory farm workers of the 1930's. Lange's photographs honestly and sympathetically portray families who were victims of drought and the Great Depression. Her pictures, which appeared in several newspapers and magazines, helped create support for government relief programmes for migrant workers. Many of Lange's photographs were published in her book *An American Exodus: A Record of Human Erosion* (1939).

Lange was born in Hoboken, New Jersey, and studied photography at Columbia University. She travelled to San Francisco in 1918 and opened a portrait studio there the next year. During World War II (1939-1945), Lange photographed many Japanese-Americans whom the government moved to relocation camps from their homes on the West Coast of America. After the war, she photographed Mormon towns, life in California, and other subjects. She also took photographs in Asia, Egypt, Ireland, and South America.

See also **Photography** (picture: Documentary photographs).



A photograph by Dorothea Lange taken in 1936 captures the despair of a migrant American family in the Great Depression.

Langenhoven, Cornelis Jacob (1873-1932), was a South African lawyer, author, and poet. He is best remembered for his poem, *Die Stem van Suid Afrika* (The Voice of South Africa), written in 1918. It was set to music by M. L. de Villiers in 1919, and was officially accepted as South Africa's national anthem in 1957.

Langenhoven was born at Hoeko, near Ladismith, in the Cape Province. His birthplace is now a museum. He studied law at the Victoria College (now Stellenbosch University). In 1901, he qualified as a lawyer and worked in Oudtshoorn, Cape Province.

In 1912, Langenhoven became editor of the *Het Zuid Westen* (The South Western), and championed the cause of the Afrikaans language (see **Afrikaans language**). In 1914, he helped establish Afrikaans instead of Dutch as the language of instruction in Cape schools.

Langland, William (1330?-1400?), wrote *Piers Plowman,* a great English poem of the Middle Ages. Scholars know little about Langland's life, but they believe he was born in Shropshire in western England and was educated in monasteries. In the late 1300's, he wrote three versions of *Piers Plowman.* All use alliteration instead of rhyme and are written in Middle English, the chief literary language of England during Langland's time.

The main theme of *Piers Plowman* is the need to reform England spiritually through Christian faith and love. The poem is a complex religious allegory in which each character represents an abstract quality or a type of person. The main character, Will, represents the will of every person who wants salvation. Piers, another character, symbolizes all true ministers of God. The action consists of Will's quest for Truth, or God. Will has nine dreams, in which most of the action occurs. The poem alternates between vivid scenes and long speeches and has much wit and power.

See also **English literature** (picture: *The Vision of Piers Plowman*).

Langley, Samuel Pierpont (1834-1906), was an American astronomer, physicist, and pioneer in aeronautics. His interest in *aerodynamics* (the theory of flight) led him to experiment with heavier-than-air flying machines. His power-driven models made a few successful flights of about 0.8 kilometre in 1896. The U.S. government later gave Langley enough finance to build a passenger-carrying "aerodrome." This machine twice was launched from a houseboat on the Potomac River in 1903. Both tests failed, but one using a smaller model succeeded. The second full-size model test was made in December 1903, shortly before the Wright brothers' epoch-making flight at Kitty Hawk, North Carolina.

Langley was born in Roxbury, Massachusetts. He spent several years studying architecture and engineering before turning to astronomy, in which he had been interested since boyhood. His several inventions included an instrument called the *bolometer,* which measures the sun's radiation (see **Bolometer**).

From 1867 to 1887, Langley was professor of physics and astronomy, and director of the Allegheny Observatory, at the Western University of Pennsylvania in Pittsburgh. He served as secretary of the Smithsonian Institution from 1887 until his death. While in this office, he established the National Zoological Park and the Astrophysical Observatory. His writings include *Experiments in Aerodynamics* (1891) and *The Internal Work of the Wind* (1893).

See also **Aeroplane** (Powered flight).

Langton, Stephen Cardinal (1165?-1228), one of England's greatest archbishops of Canterbury, was a famous theologian, Biblical scholar, and statesman. In the late 1100's, he became known as the greatest commentator on the Bible.

When King John wished to choose his own candidate as archbishop of Canterbury, Pope Innocent III objected and appointed Langton in 1207. The king refused to accept him, and Langton had to remain in exile in France. The pope placed England under an interdict, and excommunicated the king in order to force him to accept Langton. John finally accepted Langton in 1213. As archbishop, Langton defended the freedom of the church and promoted peace between John and his barons. Also, he helped bring about the Magna Carta (see **Magna Carta**).

Langtry, Lillie (1853-1929), was an English actress. She became one of the first high society women of her day to go on the stage.

Langtry was born Emilie Charlotte Le Breton on the island of Jersey. Her father was the dean of Jersey, a high official in the Church of England. Langtry also was an intimate friend of the Prince of Wales, who later became King Edward VII. Because of her high social position, Langtry caused a sensation when she performed in 1881 as Kate Hardcastle in Oliver Goldsmith's *She Stoops to Conquer.* She became known as "The Jersey Lily" as a result of her birthplace and her outstanding beauty. Langtry gained wide attention when she later toured the British Isles, South Africa, and the United States as an actress. From 1901 to 1903, she managed the Imperial Theatre in London. Her autobiography, *The Days I Knew,* was published in 1925.

Language is human speech, either spoken or written. Language is the most common system of communication. It allows people to talk to each other and to write their thoughts and ideas. The word *language* may be loosely used to mean any system of communication, such as traffic lights or Indian smoke signals. But the origin of the word shows its basic use. It comes from the Latin word *lingua,* meaning *tongue.* And a language still is often called a *tongue.*

Wherever there is human society, there is language. Most forms of human activity depend on the cooperation of two or more persons. A common language enables human beings to work together in an infinite variety of ways. Language has made possible the development of advanced, technological civilization. Without language for communication, there would be little or no science, religion, commerce, government, art, literature, and philosophy.

Scholars have determined that there are about 3,000 languages spoken in the world today. This number does not include *dialects* (local forms of a language). Many languages are spoken only by small groups of a few hundred or a few thousand persons. There are more than a hundred languages with a million or more speakers. Of these languages, 19 have over 50 million speakers each: Arabic, Bengali, Chinese, English, French, German, Hindi, Italian, Japanese, Korean, Malay-Indonesian, Marathi, Portuguese, Punjabi, Russian, Spanish, Tamil, Telugu, and Urdu. Hindi and Urdu are sometimes grouped together as Hindustani. People in many countries use some of these major languages, including English, French, Spanish, Portuguese, and Arabic. Other major languages have little use outside their own areas.

Most people learn their own language without fully realizing what is taking place. Young children feel a need to communicate their particular needs and they begin listening to older persons and imitating them.

They gradually learn to select and to make the sounds used in the language spoken around them. They also learn to disregard other possible sounds that their voices could make. At the same time, children learn to connect individual words with objects, ideas, and actions. Their responses become automatic. For example, upon seeing a dog, an English-speaking child automatically calls it a "dog." Youngsters also learn, largely by imitation, to arrange words in certain ways. By the age of 5 or 6, most children have learned the patterns of their language fairly well. They can then communicate well enough for most of their own practical purposes. In school, the language-learning process becomes conscious and deliberate. Children become aware of how the sounds and words of their language are arranged in systems. They can then learn to speak or write precisely about more complex matters.

Learning a foreign language

There are many important reasons for learning a foreign language. Among them are the following:

(1) Learning a foreign language increases your range of communication. For example, if you speak only English, you can communicate with over 400 million other persons. If you also learn Spanish, you could speak to any of the 297 million Spanish-speaking people in Latin America, Spain, and other parts of the world.

(2) By learning another language, you gain knowledge of the customs and ways of life of other nations. While learning French, you find out how French people live, behave, and think.

(3) A foreign language can help add to your knowledge of your own language. For example, by studying Latin, you can improve your understanding of many of the thousands of English words that have their roots in Latin.

(4) Learning a foreign language helps you add to your general stock of information. It can be a key that unlocks new fields of knowledge. If you learn German you will be able to read books written in German on almost any subject you may wish to study.

(5) Knowledge of a foreign language can help you gain a spirit of broad human tolerance. You will find that other peoples may think, speak, and act in ways different from yours. But these ways are not necessarily less desirable than yours.

Learning any language involves four different skills: (1) speaking, (2) understanding, (3) reading, and (4) writing. If you understand a foreign language, and can make yourself understood in speech and writing, you have mastered it.

Methods of study. No language is easy or difficult in itself. The ease or difficulty of any language depends on the age of the person learning it. Before the age of 10, all languages are equally easy when learned by the *natural speaking* method (listening and imitating). After 10, our language habits are set in our own tongue. From then on, another language is easy insofar as it resembles our own language. It is difficult insofar as it differs from our own. Therefore, it is desirable to learn foreign languages as early as possible. Some children start foreign language learning in primary school.

After the age of 10, students can learn foreign languages by either, or both, of two methods: (1) the grammar method, and (2) the spoken language method.

In the *grammar* method, students learn general rules of grammar and apply them to specific situations. A French grammar lesson may stress the correct use of *gender* (masculine or feminine). Students learn that *le livre* (the book) is masculine and *la chaise* (the chair) is feminine. In this way, they learn grammar while they increase their vocabularies.

In the *spoken language* method, students try to duplicate the process by which young children learn language. They listen to the teacher, then imitate the sounds, words, and sentences.

Both the grammar method and the natural speaking method are effective. The ideal method for older children and adults seems to be a combination of the two.

Study aids. For hundreds of years, language students have used grammar books, exercise books, and dictionaries. Modern study aids—especially for spoken language—include (1) voice recordings with accompanying booklets; (2) tape recorders, which permit students to listen, repeat, erase their own repetition, then try again; (3) videotapes and closed-circuit TV's, which let students watch their mouth movements and compare them with those of a speaker; and (4) computers, which correct student translations of words and phrases on a video display screen. These language study aids provide not only instruction and practice, but also self-instruction, because they can be used without a teacher.

The makeup of language

All languages have certain things in common. These include (1) a sound-pattern, (2) words, and (3) grammatical structure.

A sound-pattern is a group of sounds that the human speech organs can utter. Most languages have from 20 to 60 of these sounds.

Words are sounds or sound-patterns that have a meaning. Words may stand for objects, actions, or ideas.

Grammatical structure is the manner in which words are combined to form larger, meaningful units such as sentences. Grammatical structure may take either or both of two forms. One form, called *syntax,* is the arrangement of words in a particular order. The order of words makes their meaning clear. In English, when we say *John sees Mark,* we show that *John* is the doer of the action and *Mark* the receiver. We do this by putting *John* before *sees* and *Mark* after *sees.* Other languages use quite different orders. However, as long as the meaning depends on word order, the languages are using syntax.

The other form of grammatical structure is called *morphology.* It uses a variation in the form of a word to show the function of the word in a group. In Latin, both *Johannes videt Marcum* and *Videt Marcum Johannes* mean *John sees Mark.* In this case, we know that *Johannes* (*John*) is the doer of the action, no matter where the word occurs, because it ends in *-s* (not *-m*). Similarly, we know that *Marcum* (*Mark*) is the receiver because it ends in *-m* (not *-s*).

Some languages, such as Chinese, use syntax only. In other languages, such as Latin, the word order has little importance because word endings tell the story. Old English, or Anglo-Saxon (the form of English spoken until about A.D. 1100), resembled Latin in this way.

A language laboratory provides self-instruction in speaking and understanding a foreign language. The lab has tape recorders, headphones, and special desks. The recorders allow students to record their own voices. They use the headphones to listen to their pronunciation or to the pronunciation of the teacher. The walls help keep out distractions.

Modern English uses a blend of syntax and morphology. When we say *I see him,* we give two indications that *I* is the doer and *him* is the receiver. One indication is the position of *I* before *see* and *him* after *see.* The other is the fact that we use *I* (not *me*) for the doer, and *him* (not *he*) for the receiver.

Development of language

The makeup of a language does not remain the same over long periods of time. Grammar, vocabulary, and sound-patterns all change with usage.

How language began. No one knows how language began. Because all people who are not handicapped have the ability to speak, language has probably existed at least as long as the modern human species. Most scholars believe that language developed very slowly from sounds, such as grunts, barks, and hoots, made by prehuman creatures. According to this view, a simple system of vocal communication became more complex as the human brain and speech organs evolved. But no one knows when or how this process took place. In fact, there is no record of language for most of its existence. The first real evidence of language is writing. But scholars believe that writing did not appear until thousands of years after the origin of spoken language. The earliest known written records are Sumerian word-pictures made about 3500 B.C. and Egyptian hieroglyphics that date from about 3000 B.C. (see **Hieroglyphics**). Written Chinese dates from perhaps 1500 B.C., Greek from about 1400 B.C., and Latin from about 500 B.C.

How language changes. No one knows all the reasons why languages change, but they continue to do so as long as people speak them. In a few cases, the changes can be explained. For example, words are added to a vocabulary to refer to new ideas or objects. Contacts between speakers of different languages may cause words from one language to enter another.

Most language changes occur for unknown reasons. Languages do not become better or worse, only different. The change is very slow. People who speak English do not notice that their own language is changing from one year to the next. But if present-day speakers of English try to read Old English, they find that it is as unlike modern English as are French or German. In modern industrial societies, language changes take place even more slowly. Educational systems and such centralized communication systems as radio and television promote the use of a standard form of a language. Under these conditions, a language is likely to remain more stable. However, language will probably never stop changing entirely.

Only when a language loses all its speakers does it

Linguistic terms

*__Accent__ is the emphasis placed on a certain syllable of a word. We accent the syllable *lan* in the word *language.*

Agreement occurs when one part of speech changes its form to conform with another part. For example, the word *come* changes to *comes* when used with a third person singular subject, as in *he comes.*

Blend is a word made up of parts of two or more other words. *Brunch* (breakfast and lunch) is a blend.

Cognates are words in different languages that have the same original source. The English word *water* and the German word *Wasser* are cognates.

Coinage is an invented word. Manufacturers coined the words *kodak* and *zip* to advertise their products.

Colloquialism is an informal, but not slang, expression such as *I've got it.* Colloquialisms are out of place in formal speech, but are widely used in daily speech.

*__Diacritical mark__ is a written sign used to show changes in sounds and pronunciation. The Spanish *tilde* (˜) gives an *n* an *ny* sound.

*__Etymology__ is a branch of linguistics that studies the origin and development of words.

Hybrid word is composed of parts from two or more languages. In the word *automobile, auto* comes from Greek and *mobile* from Latin.

*__Idiom__ is an expression in one language that cannot be accurately translated into another. The meaning of an idiom cannot be seen from the individual words in it. For example, *Look out!* means *Be careful!*

*__Illiteracy__ is the inability to read and write.

Jargon is a vocabulary and set of expressions used by a particular group of persons. Doctors, for example, use many words and expressions not used by the general public.

Loan word, such as *spaghetti,* is borrowed from another language, either in its original form or modified.

*__Linguistics__ is the scientific study of language in the broadest sense. *Philology* is an older term for the scientific study of language.

Neologism is a newly coined word that has not been generally accepted. *Grismal,* a combination of *grim* and *dismal,* is a neologism used by some Americans. The term also refers to the use of a word in a new meaning. For example, *contact* was once only a noun. Today, it is also a verb, as in *We will contact you,* and an adjective, as in *Football is a contact sport.*

*__Semantics__ is the study of the meaning of words.

*__Slang__ consists of words and phrases that are used in unconventional ways. An example is the word *grub* (food). The slang expression *wally* means a *silly person.*

Vernacular is the spoken language of any area.

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*Has a separate article in *World Book.*

stop changing completely. A language that is no longer spoken is called a *dead language.* Such languages include Sumerian, ancient Egyptian, Akkadian, Hittite, Etruscan, and Gothic.

Language families

Scholars classify languages into families. Language families are groups of languages that are related because they all developed slowly from a single earlier language called a *parent language.* When speakers of a language become divided into groups that are out of contact with each other, the language of each group continues to change in its own way. After several centuries, the individual groups speak so differently that they cannot understand each other. But the languages in each family are still related because all of them came from the same parent language.

Indo-European is the most important language family. Some 2,400,000,000 people, or about half the world's population, speak languages in this family. Most of the nations that gave rise to Western civilization speak Indo-European languages. Speakers of these languages originally lived in an area extending from northern India to western Europe. They now live in other parts of the world as well. Indo-European languages have become the most important tongues in most European countries, in Australia and New Zealand, and in the countries of North, Central, and South America.

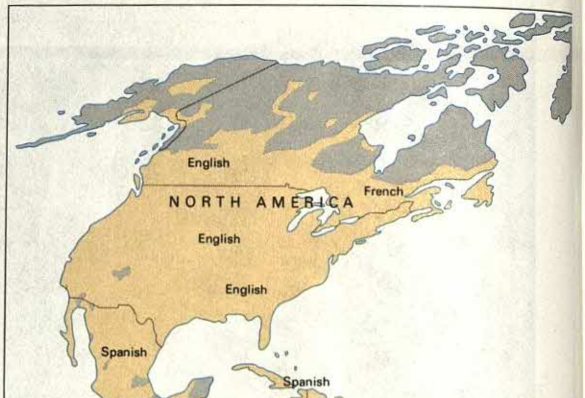
The Indo-European family has eight living branches. They are: (1) *Germanic,* or *Teutonic,* which includes English, German, Dutch, and the Scandinavian tongues—Danish, Icelandic, Norwegian, and Swedish; (2) *Romance,* or *Latin-Romance,* including French, Spanish, Portuguese, Italian, and Romanian; (3) *Balto-Slavic,* including Russian, Ukrainian, Polish, Czech, Slovak, Serbo-Croatian, Slovenian, Bulgarian, Lithuanian, and Latvian; (4) *Indo-Iranian,* which includes Hindi, Urdu, Bengali, Farsi, and Pashto; (5) *Greek;* (6) *Celtic,* including Irish (Gaelic), Scots Gaelic, Welsh, and Breton; (7) *Albanian;* and (8) *Armenian.*

All languages in the Indo-European family have the same original structure, based on *inflections* (see **Inflection**). They all have clearly defined parts of speech. These include nouns, adjectives, pronouns, and verbs, which take certain endings to show gender, number, case, person, tense, mood, or voice. Many simple, basic words are similar in Indo-European languages. For example, the English word *mother* is *mata* in Sanskrit, *meter* in Greek, *mater* in Latin, *madre* in Spanish, *Mutter* in German, and *mat′* in Russian.

Speakers of the parent Indo-European language probably lived in the area north of the Black Sea. From there, they probably migrated in every direction, changing the language along the way. The earliest Indo-European language of which we have a record is Hittite, followed by Greek and Sanskrit.

Other language families. Besides Indo-European, scholars have discovered many other language families.

The Sino-Tibetan family is second in numerical importance, with about 1,100,000,000 speakers. It includes Chinese with its many dialects, Thai, Burmese, and Tibetan. These languages are the leading languages of East Asia. The Sino-Tibetan languages consist of one-syllable words. Speakers show the different meanings of otherwise identical words by using *tones* (changes in the pitch of the voice).



Major language families and languages

The colours on the map represent the chief language families. The names identify the main languages in the families. The chart on the opposite page shows the approximate percentage of the world's people that speaks the languages in the chief families. Black African includes three major families.

The Afro-Asian family includes Arabic and Hebrew, the Berber tongues of North Africa, and the Amharic of Ethiopia. About 220 million people speak languages in this family, which is concentrated in North Africa, the Near East, and northeast Africa.

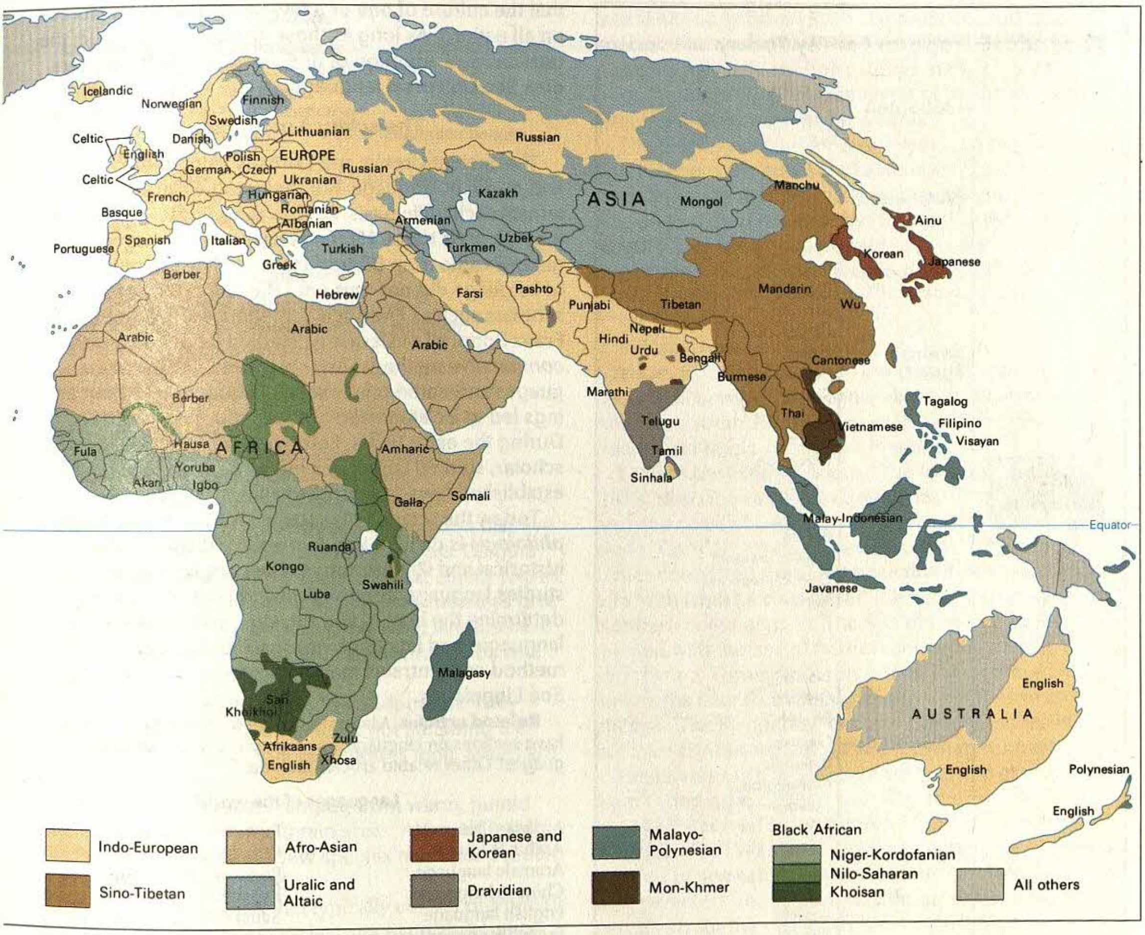
The Ural-Altaic family includes Finnish, Estonian, Hungarian (or Magyar), Turkish, and many languages in central and northern Asia. About 130 million people speak the languages in this family, which is found in Finland, Estonia, Hungary, Turkey, Turkmenistan, Uzbekistan, Kazakhstan, Mongolia, and Siberia.

Japanese and Korean form a family with about 181 million speakers. They are largely limited to Japan, North Korea, and South Korea.

The Dravidian family is located in southern India and parts of Sri Lanka. It consists of Tamil, Telugu, and other languages. These languages have about 210 million speakers. See **Dravidians.**

The Malayo-Polynesian family includes the languages of Malaysia, Indonesia, the Philippines, Hawaii, New Zealand, Madagascar, and most other islands of the Pacific and Indian oceans. This language family has about 270 million speakers.

The Mon-Khmer family has about 80 million speak-



ers in Southeast Asia and parts of India. This family is sometimes called Austro-Asiatic. It includes the languages spoken in Cambodia (Kampuchea), Assam, parts of Burma, and Vietnam.

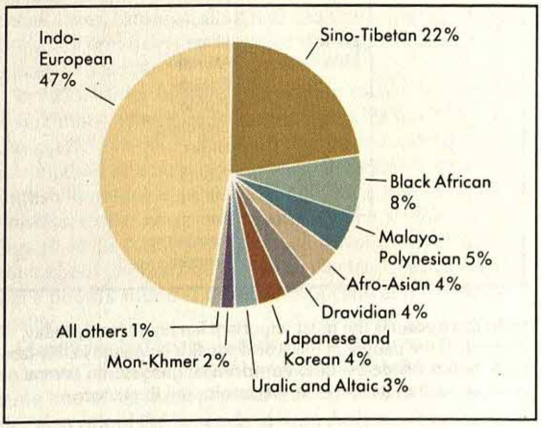
Black African languages are spoken in areas south of the Sahara and west of the Sudan, Ethiopia, and Somalia. The three main families of these African languages are Nilo-Saharan, Niger-Kordofanian, and Khoisan. These three groups have about 430 million speakers.

American Indian languages number over 1,000. But they are difficult to classify because of the great differences among them. Their total number of speakers does not exceed 20 million. These languages appear in isolated areas of North, Central, and South America.

Unusual languages and dialects include the pidgin and Creole tongues spoken in many parts of the world. They make communication possible between two or more groups that speak different languages. Examples include the colourful Melanesian pidgin English of the Solomon Islands and Papua New Guinea; and Haitian Creole, based on French. See **Creole; Pidgin English.**

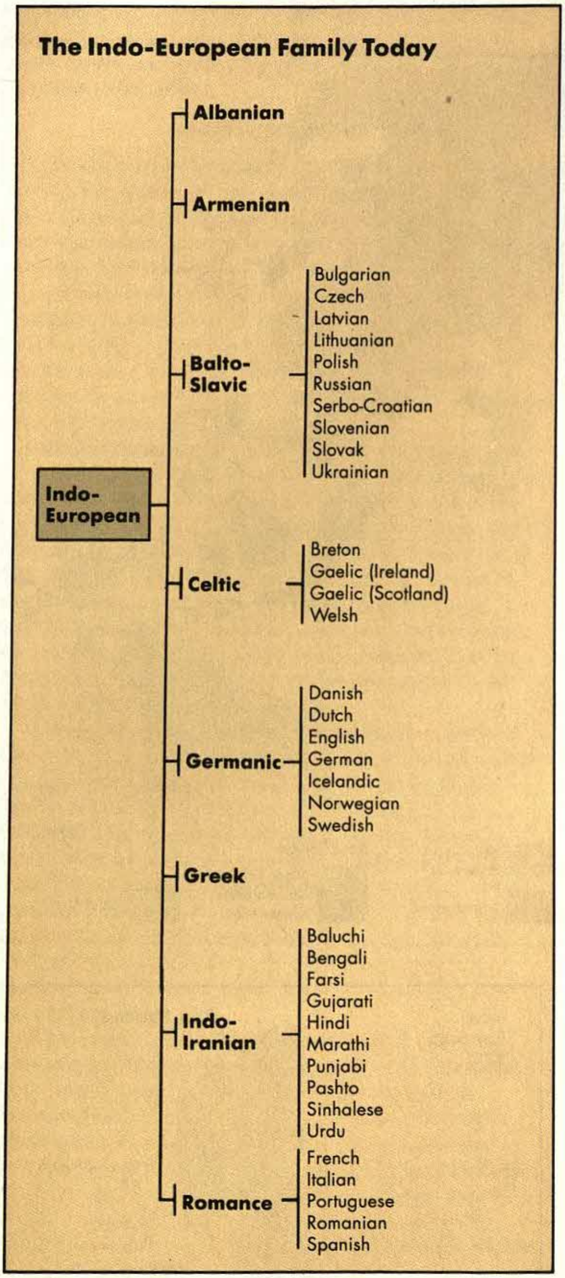
Universal languages

People have long been interested in having one language that could be spoken throughout the world. Such a language would help promote understanding and better feeling among nations. A universal language also would increase cultural and economic ties among various countries.



Through the years, at least 600 universal languages have been proposed. *Esperanto* is the most successful universal tongue. About 10 million people have learned Esperanto since its creation in 1887.

Some people suggest that an existing language, such



Indo-European is the most important language family today. About half the people in the world speak a language in this family. Scholars divide the Indo-European languages into several groups, such as Balto-Slavic, Germanic, and Romance.

as English, French, or Russian, be adopted as a universal language. The adoption of any language, artificial or natural, would greatly simplify communication among nations. The problem, however, lies in the choice of such a language, because there are so many possibilities.

Many people oppose artificial languages. They believe that an artificial tongue does not reflect a true culture as existing languages do. Others oppose the use of any existing language as a world language. They claim that the culture of one or a few nations would be forced on all nations. As long as these arguments continue, the possibility of adoption of one world language appears dim. See **Universal language.**

The science of language

The ancient Greeks and Romans studied the nature and origin of language. But their studies lacked a systematic, scientific basis. During the Middle Ages, from the A.D. 400's to the 1500's, many people thought all languages came from Biblical Hebrew. The scientific study of language did not start until the late 1700's. At first, scholars such as Friedrich Schlegel, Jakob Grimm, and Franz Bopp, all of Germany, studied languages by the *comparative* method. They compared the world's languages and noted relationships among them. Their findings led to a classification of languages into families. During the early 1900's, Ferdinand de Saussure, a Swiss scholar, studied languages by the *general* method. He established laws that apply to all languages.

Today, the science of language (called *linguistics* or *philology*) is divided into two areas: (1) comparative or historical and (2) descriptive. The comparative method studies language through thousands of years. It seeks to determine the history and development of individual languages and language groups. The descriptive method concentrates mainly on present-day languages. See **Linguistics.**

Related articles. Many ***World Book*** articles on countries have sections on language. For example, see **Canada** (Languages). Other related articles include:

Languages of the world

Afrikaans language
Arabic language
Aramaic language
Chinese language
English language
French language
Gaelic language
German language
Greek language
Hebrew language and literature
Italian language
Japanese language
Latin language
Portuguese language
Russian language
Sanskrit language and literature
Semitic languages
Spanish language
Yiddish language

Spoken language

Dialect
Oratory
Phonetics
Pronunciation
Speech
Vocabulary
Voice

Written language

Cuneiform
Hieroglyphics
Punctuation
Rune
Writing

Other related articles

Accent
Alphabet
Anthropology (Linguistic anthropology)
Celts
Communication
Consonant
Creole
Dictionary
Esperanto
Etymology
Figure of speech
Grammar
Idiom
Illiteracy
Interlingua
Inuit (Language)
Linguistics
Literature
Pacific Islands (Languages)
Pidgin English
Reading
Semantics
Sentence
Sign language
Slang
Teutons
Universal language
Volapük
Vowel

Outline

I. Learning a foreign language
  A. Methods of study
  B. Study aids
II. The makeup of language
III. The development of language
  A. How language began
  B. How language changes
IV. Language families
  A. Indo-European
  B. Other language families
  C. Unusual languages
V. Universal languages
VI. The science of language

Questions

How can learning a foreign language help you?
What three things do all languages have in common?
What is the chief language family?
What are the earliest written records of language?
What is the difference between *syntax* and *morphology*?
Why do some people oppose a universal language?
What is a *parent language*?
When does a language become a *dead language*?
How many languages are spoken in the world?
What are some reasons why languages change?

Langur is any of about 15 species of monkeys that live throughout India and most of Southeast Asia. Langurs are called "leaf-monkeys" because they eat chiefly leaves. The large stomach and intestines of these monkeys give them a potbellied appearance. Otherwise, langurs have a slender body, with a long tail. Their coat may be red, brown, silver, grey, or black.

Adult langurs weigh from 5 to 18 kilograms. They measure 45 to 80 centimetres long, not including the tail, which may be 55 to 105 centimetres long. Males are larger than females.

Langurs live in habitats ranging from warm, humid swamp forests to cold mountain areas. Almost all species live mainly in trees. A few species may spend much of their time on the ground.

Langurs live in groups that typically consist of from 10 to 40 members. Adult female langurs mate about once every two years. A pregnant female carries her young inside her body from 150 to 220 days, depending on the species. She almost always gives birth to one baby, but twins occasionally are born. Langur babies are often brightly coloured. Other members of the group may help the mother care for her young.

The langur is a leaf-eating monkey that lives in India and Southeast Asia. The Hanuman langur, *above,* has a long tail and black face and hands. Hindus regard it as a sacred animal.

The clearing of land for farming and timber production threatens the survival of a number of langur species. One such species, the Hanuman langur, is regarded as a sacred animal by Hindus. For this reason, langurs have long been protected in India.

Scientific classification. Langurs belong to the Old World monkey family, Cercopithecidae. The Hanuman langur is *Presbytis entellus.*

See also **Monkey** (picture: Douc langur).

Lanier, Sidney (1842-1881), was an American poet. He became famous for his poems about the beauty of the American South. Lanier's works also include children's poems and books on English literature.

Lanier's best-known poem, "The Marshes of Glynn" (1878), describes a wild, swampy, heavily wooded area near the coast of Georgia. His other major poems include "Corn" (1875) and "The Symphony" (1875). In "Corn," Lanier contrasted the abundance of Southern agriculture with what he considered the false, sterile values of Northern commerce. In "The Symphony," he experimented with the use of musical concepts, such as tone and rhythm. Throughout this poem, Lanier attempted to imitate the sounds of the various instruments of an orchestra. "The Symphony" became popular in the 1800's, but later critics have not ranked it among his best works.

Lanier was born in Macon, Georgia, and graduated from Oglethorpe College (now Oglethorpe University) in 1860. He served in the Confederate Army during the American Civil War (1861-1865) and spent four months in a Union prison camp. Lanier returned to Macon after the war, penniless and in poor health. He suffered from tuberculosis for the rest of his life. In 1867, he published his only novel, *Tiger-Lilies,* an account of his war experiences. Later, Lanier studied law and then entered his father's law firm because he could not earn enough money as a writer.

In 1873, Lanier resumed his writing career. He moved to Baltimore, where he helped support his family by playing flute in the Peabody Orchestra. He soon gained a reputation as a poet and, in 1879, became a lecturer in English literature at Johns Hopkins University. At Johns Hopkins, Lanier wrote such works as *The Science of English Verse* (1880) and *The English Novel* (1883). In his book about English poetry, Lanier declared his belief that a poem's sound is its most important and exciting quality.

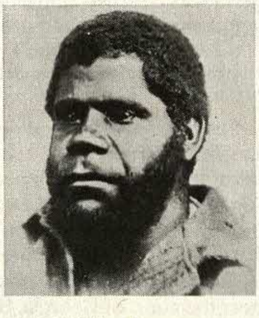
During his last years, Lanier edited children's books. He wrote "The Revenge of Hamish" (1878), which became one of his most popular poems for children. Lanier also retold the legends of King Arthur's court in *The Boy's King Arthur* (1880).

See also **American literature** (Individualists).

Lankester, Sir Edwin Ray (1847-1929), a British zoologist, did extensive research in comparative anatomy and embryology. His work helped support the theory of evolution (see **Evolution**). Lankester was professor of zoology and comparative anatomy at the University of London from 1874 to 1890. He served as director of the British Museum's natural history department from 1898 until his retirement. From 1869 to 1920, he edited *The Quarterly Journal of Microscopical Science.*

Lankester was born in London. He studied at Cambridge and Oxford universities.

Lanney, William (1835-1869), was the last male tribal Aborigine in Tasmania. His family was the last Aboriginal group to surrender to the Europeans and to leave their tribal lands. They arrived at Wybalenna on Flinders Island in 1842, when William was aged 7. The family consisted of his mother, Nabrunga; his father, John Lanna; and his four brothers, Barnaby Rudge, Charles, Pleti, and Francis. They gave themselves up near the Arthur River on the West Coast, because they were lonely.


William Lanney.

William spent the next five years at Wybalenna. During this time, his parents and three of his brothers died. In 1847, when William was 12, he was one of 15 men, 22 women, and 10 children who had survived Wybalenna. The adults were moved to the unused convict station at Oyster Cove, but William was transferred to the Orphan School in Hobart Town. He spent four years there, where overcrowding, poor food, and severe punishment made his life unhappy.

In 1851, Lanney began a whaling apprenticeship with two other young men, Jack Allen and Adam Cochrane. The government had decided that able-bodied people should be put to work to cut costs. After beginning his apprenticeship, Lanney rarely spent time at Oyster Cove, and therefore was not exposed to the disease and despair that overwhelmed the other Aborigines who had been settled there.

When Lanney became the last surviving male tribal Tasmanian Aborigine, the colonists gave him the nickname *King Billy.* In 1864, he lodged an official complaint with the Colonial Secretary: "I am the last man of my race and I must look after my people." Apparently, there was a food shortage at the Oyster Cove station. Perhaps his proudest moment came in 1868, when he was introduced as the "king of the Tasmanians" to the Duke of Edinburgh, on a visit to Hobart Town.

William Lanney died on March 6, 1869, at the age of 34. He had returned from a whaling trip ill with cholera. His body was taken to the morgue at the Colonial Hospital, where scientists severed his head to examine it for "scientific" purposes. They replaced it with the head of a European. Further mutilation occurred after the body was exhumed after burial in St. David's Cemetery. Only the hands and feet have ever been recovered.

Lanolin, or *wool fat,* is made from a greasy coating found on sheep's wool. The name is used especially when the wax is purified and mixed with water. Lanolin is a yellowish, sticky substance, as thick as ordinary wax. It does not react readily with acids or alkalies. It will absorb from 25 to 30 per cent of its own mass in water. When lanolin is mixed with water, it breaks up easily into tiny droplets. This forms an emulsion known as *hydrous lanolin,* or *lanolin USP* (see **Emulsion**). Hydrous lanolin is widely used in medicines such as salves and ointments, and in cosmetics, because it is easily absorbed by the skin. Lanolin is also used as a dressing for leather goods, as a protective coating for metals, and as a base in grease paints and shoe polishes.

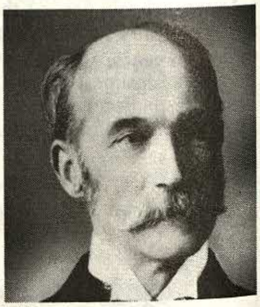
Lansbury, George (1859-1940), was a pioneer of the British Labour movement. At first a Liberal, he became a Socialist in 1892 and was elected to Parliament in 1910. He resigned in 1912 over women's *suffrage* (right to vote), which he strongly supported. He founded the national newspaper, the *Daily Herald* and edited it until 1922, when he returned to Parliament.

George Lansbury

In 1929, Lansbury was appointed to the government post of First Commissioner of Works, and in 1931 he became Leader of the Opposition. He resigned in 1935. Lansbury was born near Lowestoft in Suffolk, England.

Lansdowne, Marquess of (1845-1927), was a British colonial administrator who served as governor general of Canada from 1883 to 1888. As governor general, Lansdowne supported construction of the coast-to-coast Canadian Pacific Railway (now CP Rail). The railway was completed in 1885.

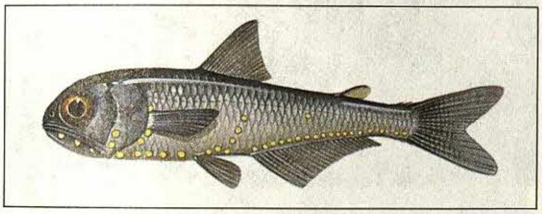
Lansdowne was born Henry Charles Keith Petty-Fitzmaurice, in London. Upon the death of his father in 1866, he became the fifth marquess of Lansdowne and inherited one of the largest estates in England. From 1888 to 1893, Lansdowne served as *viceroy* (ruler) of India, then a British colony. He was British foreign secretary from 1900 to 1905. During this period, he helped Britain work out a military treaty with Japan and an agreement of friendship with France called the *Entente Cordiale.*


Lord Lansdowne

Lantern is any light enclosed in a casing that protects it from wind and rain. The light is provided by electric batteries, carbide gas, petrol, or paraffin. Some lanterns can be carried from place to place. Lanterns are used on ships and trains, as warning signals at railway crossings, and for ornamental purposes.

Lanternfish is the name of a large group of small fish with organs that give off light. The ability of certain living things to produce light is called *bioluminescence* (see **Bioluminescence**). More than 1,000 species of fish are bioluminescent. Most of them, including lanternfish, live in the deep waters of the open sea in all parts of the world.

There are more than 230 species of lanternfish. Most adult lanternfish measure less than 15 centimetres long. The fish's light-producing organs, called *photophores,* develop chiefly on the lower part of the body. Each species has a different arrangement of photophores. Lanternfish use their bioluminescence to communicate with one another and to attract prey. Their light also provides a type of camouflage that helps protect them from enemies. The fish are invisible from below because their glowing undersides match the light levels of the sunlit or moonlit sea surface. In addition, the dark, unlighted backs of many lanternfish match the darkness of the deep water, so that they are invisible to enemies above.



The lanternfish has organs along the sides of its head and body that enable the fish to create its own light.

Lanternfish often form shoals of hundreds of thousands of fish. They are found at greater depths during the day and migrate to shallower depths at night.

Scientific classification. Lanternfish belong to the lanternfish family, Myctophidae.

Lanthanide. See **Rare earth; Element, Chemical** (Periodic table of the elements).

Lanthanum is a soft, silvery-white metallic element. It tarnishes rapidly when exposed to air. Lanthanum is found in rare earth mineral ores such as monazite and bastnasite. It also can be produced in nuclear reactors by the fissioning of uranium, thorium, or plutonium. The Swedish chemist Carl Mosander first identified lanthanum in 1839. Its name comes from a Greek word meaning *to be hidden* or *concealed.*

Lanthanum forms part of an alloy called *misch metal,* which is used in making flints for cigarette lighters. Lanthanum oxide is added to the glass used for camera lenses to increase its ability to *refract* (bend) light.

Lanthanum has an atomic number of 57 and an atomic weight of 138.906. It melts at 921° C and boils at 3457° C.

See also **Element, Chemical** (table); **Rare earth.**

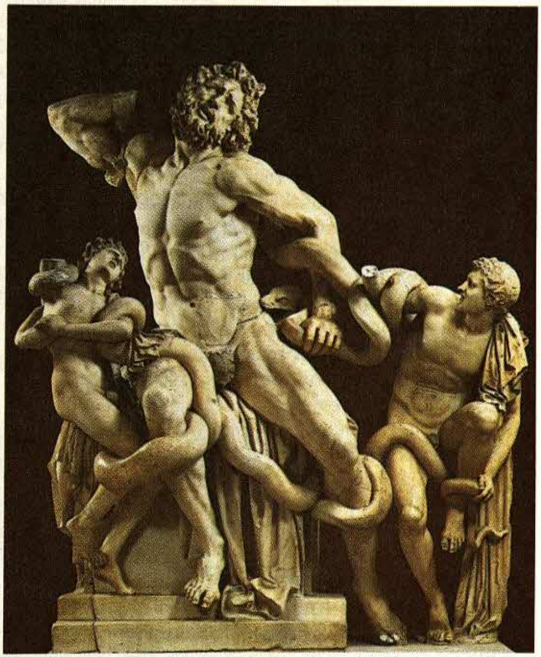
Lanzhou (pop. 1,460,000), also spelled *Lan-chou,* is the capital of Gansu Province in north-central China. For the location of Lanzhou, see **China** (political map). It was known as the *Gateway to China* in the Middle Ages. At that time, the city was an important stop on the Silk Road, a caravan route to the West. Marco Polo and other traders travelled the Silk Road, carrying Chinese goods to Europe and western Asia. A large proportion of China's relatively few Muslims live in Lanzhou. Many are descended from Arab traders and soldiers.

After the Communists took over China in 1949, Lanzhou became an important centre for the industrial development of China's northwest. The city now has factories that produce chemicals, machinery, and petroleum and lubricants. Railways link Lanzhou with cities to the north, east, and south.

Lao Tzu. See **Laozi.**

Laocoön, a Trojan priest, warned his people against the Greeks at Troy. The Trojans and the Greeks had been at war for 10 years. Pretending to give up the siege, the Greeks left a huge wooden horse outside the gates of Troy. Laocoön suspected treachery, and told the Trojans not to take the horse inside the city walls. "I fear the Greeks, even when bringing gifts," he said.

Later, as Laocoön worshipped, two sea serpents attacked him and his sons and crushed them to death. Believing this to be a punishment from the gods, the Trojans rejected Laocoön's warning and took the wooden horse into the city. Laocoön had been right. The horse concealed Greek soldiers who came out of the horse during the night, and captured the city. Virgil describes the death of Laocoön in the second book of the *Aeneid.*



Restored marble statue (about A.D. 100), by Agesander, Polydorus, and Athenodorus of Greece; Vatican Museums, Rome.

Laocoön was a Trojan priest in Greek mythology who warned his people against the Greeks during the Trojan War. Two sea serpents attacked him and his sons and crushed them to death.

See also **Trojan War.**

Laois is a landlocked rural county in the province of Leinster in the Republic of Ireland. It forms part of the central lowland of Ireland. The name Laois is sometimes spelled *Laoighis* or *Leix.* The largest town and main service centre is Port Laoise.

People and government. For Laois' total population, see the *Facts in brief* table with this article. About 73 per cent of the people live in rural areas.

Nearly 93 per cent of the people of Laois are Roman Catholic. Most of the remainder are members of the Church of Ireland.

Five members of parliament represent Laois and Offaly together in *Dáil Éireann,* the lower house of the Irish legislative assembly. A county council, based in Port Laoise, is in charge of local government. The Republic of Ireland's top security prison is also located there.

Facts in brief about Laois

Population: *1991 census*—52,325.
Area: 1,719 km².
Largest towns: Port Laoise, Portarlington, Mountmellick, Abbeyleix, Mountrath.
Chief products: *Agriculture*—barley, cattle, milk, pigs, sugar beet, wheat. *Other primary products*—peat, timber. *Manufacturing*—engineering goods, grain and meat products, rubber products, textiles, timber goods.
Origin of name: From the name of the local Gaelic territory.

Economy. About a quarter of the people of Laois work in agriculture. Most of the land that is not peat bog or upland is used for farming. A fifth of it grows crops such as barley, potatoes, sugar beet, turnips, and wheat. The remainder is grassland and is used mainly for beef cattle production. There is also dairy farming and pig production. Some farmers rear sheep.

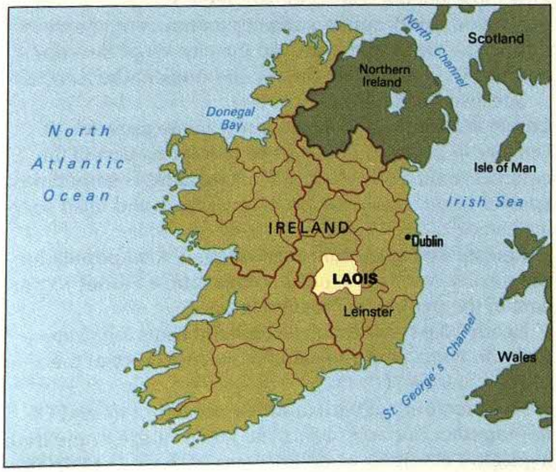
Nearly half of the county's workers have jobs in service industries. Retail and wholesale distribution is the main activity. Other services include catering, education, health, public administration, and transport.

One-sixth of people in County Laois work in manufacturing. Food processing and general engineering are the main industries. Other manufactures include plastic, rubber, textile, and wood products. Portlaoise is the principal industrial centre.

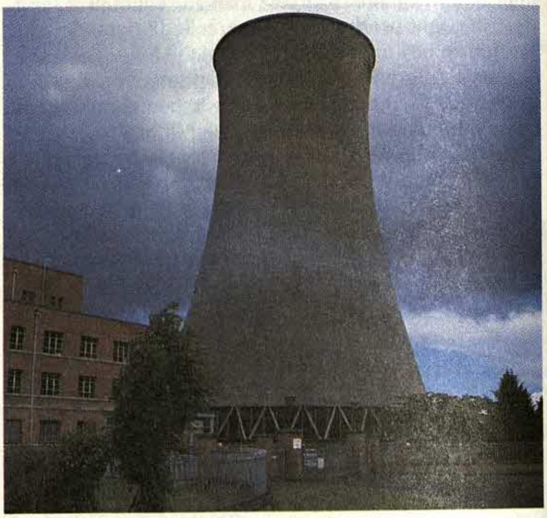
Ireland's first peat-burning electricity generating station opened at Portarlington in 1950. A factory processes peat moss near Port Laoise. The county has some coal mining and stone cutting, and forestry is also important.

Port Laoise is a major focus of road routes. There the N8 road to Cork joins the N7 from Dublin to Limerick. Portlaoise also lies on the N80 road from Athlone to Wexford. The railway from Dublin to Cork and Limerick passes through Laois, with branches from Portarlington to Athlone and from Ballybrophy to Nenagh.

Land. The boundaries of Laois are with Offaly to the northwest and west, Kildare and Carlow to the east, Kilkenny to the south and Tipperary to the southwest. The longest distances are 50 kilometres from east to west and 40 kilometres from north to south.



Laois is an inland county in the Republic of Ireland and forms part of the province of Leinster.



Portarlington, in Laois, has the Republic of Ireland's first peat-burning electricity generating station.

Most of Laois is an undulating lowland made of limestone, drained by the rivers Nore and Barrow. There are peat bogs in some poorly drained places. The larger part of the Slieve Bloom Mountains lies within Laois, along its western boundary with Offaly. The mountains consist of sandstone, slate, and shale, and rise to over 500 metres. The River Barrow rises there and flows along the eastern boundary of the county. The Castlecomer plateau in southeast Laois consists of shale and sandstone and rises to over 300 metres.

The annual rainfall in Laois is 100 centimetres, but on the Slieve Bloom Mountains it is 140 centimetres. The average monthly temperatures are 5° C in January and 16° C in July.

History. The area now occupied by County Laois was once part of the ancient Irish kingdom of Ossory. The O'Mores were the main family in control of the territory. The rule of the O'Mores was interrupted temporarily by the arrival of the Anglo-Normans in the late 1100's. English control finally came with the Tudor plantation of the 1500's, when English colonists settled in the county. Laois was named *Queen's County* after Queen Mary Tudor. The chief towns date only from that period and later. Portarlington had many Huguenot settlers and Mountmellick was a Quaker settlement. Abbeyleix was a town associated with the adjacent great mansion of Abbeyleix House, built in the 1700's. During the Great Famine in the 1840's, more than a quarter of the population of Laois died or emigrated from the county.

In 1981, Laois County Council adopted the family coat of arms, *left,* of one of the county's greatest families—the O'Moores, or Uí Mórdha in Gaelic.

Laotian women often wear colourful homespun skirts. Most Laotians live in rural villages and make their living by farming.

Laos is a country in Southeast Asia. It is a tropical land of mountains and thick forests drenched by heavy rains. Laos has rich soil and valuable mineral deposits, but its economy has never been developed. The country's official name is the Lao People's Democratic Republic. Vientiane is its capital and largest city.

France ruled Laos as part of French Indochina for more than 50 years. In 1954, an international agreement recognized Laos as an independent, neutral nation. But civil war broke out in 1960 between Laotian government troops and the Communist-led *Pathet Lao* (Lao Country) forces. Another international agreement in 1962 failed to settle the differences, and fighting continued throughout the 1960's and early 1970's. In 1975, the Pathet Lao won the war and took control of Laos.

Government. Laos was a constitutional monarchy before the Pathet Lao victory in 1975. A king was officially the head of state, but he actually had little power. A coalition government made up of Communists and non-Communists ruled the country.

The Pathet Lao abolished the coalition government and the monarchy after they gained control of Laos. They set up a Communist government. In August 1991, Laos adopted its first constitution since the Communist takeover. Under the constitution, the government is headed by a president. The president appoints a prime minister and a cabinet to help carry out the functions of the government. A lawmaking body called the National Assembly elects the President to a five-year term. The National Assembly has 85 members, elected by the people. Members serve five-year terms.

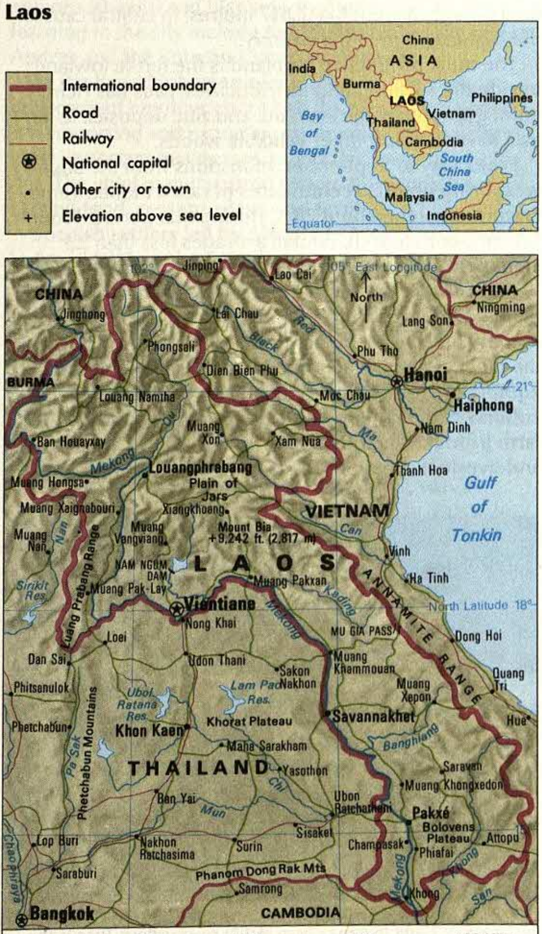
People. The people of Laos belong to two language groups, the Sino-Tibetan from China, and the Mon-Khmer from southern Asia. The Sino-Tibetan language group includes the *Lao, Hmong* (also called *Meo*), and *Tai* peoples. The Mon-Khmer group includes the *Kha* peoples. Laos' official language, Lao, is similar to the language of Thailand.

The Lao, who make up about half of the population, are the political and social leaders. The Kha, the original inhabitants of Laos, have traditionally been treated as little more than slaves by the Lao. The Pathet Lao have worked to improve the status of the Kha since they took over Laos. Most of the Tai live in northern valleys. The Hmong live on the mountain slopes. They produce most of Laos' opium, an illegal but profitable export.

Almost all the people of Laos are farmers. Most of them grow rice along the Mekong River and its tributaries. Laotians who live in the highlands grow maize, cotton, rice, and tobacco. The people live in houses perched on wooden posts 2 to 2.5 metres above ground. The houses have covered porches, bamboo floors and walls, and thatched roofs.

Most Laotian village dwellers are poor. Their lives are a continual round of planting and harvesting crops. Almost half of the people 15 years of age or older can read and write. Many villages do not have schools. Most Laotians are Buddhists, and much of the country's social life centres on Buddhist festivals and holidays.

Laos



Facts in brief about Laos

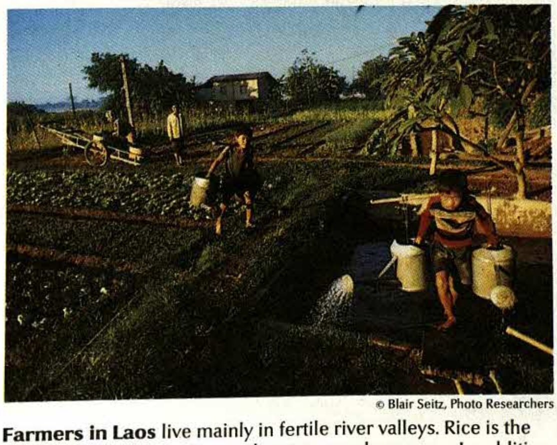
Capital: Vientiane.
Official language: Lao.
Area: 236,800 km^2. *Greatest distances*—northwest-southeast, 1,046 km; northeast-southwest, 510 km.
Population: *Estimated 1996 population*—5,015,000; density, 21 people per km^2; distribution, 78 per cent rural, 22 per cent urban. *1985 census*—3,584,803. *Estimated 2001 population*—5,732,000.
Chief products: Benzoin, cardamom, cattle, cinchona, citrus fruit, coffee, cotton, leather goods, maize, opium, pottery, rice, silk, silverwork, tea, teak, tin, tobacco.
Flag: The flag has a red horizontal stripe at the top and the bottom, and a blue horizontal stripe in the centre. A white circle appears in the centre of the flag. The red symbolizes the blood and soul of the Laotian people. The blue stands for prosperity. The white circle represents the promise of a bright future. Adopted in 1975. See **Flag** (picture: Flags of Asia and the Pacific).
National anthem: "Pheng Sat" ("National Music").
Money: *Currency unit*—kip. One kip = 100 at.

Land. Laos lies in the Mekong Basin, between the Mekong River and the Annamite Range, a chain of mountains. Rugged plateaus and mountains in the north and along the eastern border range from 150 to 1,200 metres high. Mount Bia (2,817 metres) in central Laos is the highest point in the country.

The most productive farmland is the fertile lowland beside the Mekong and its tributaries. Laos has rich gold, gypsum, lead, silver, tin, and zinc deposits. Its forests have teak and other valuable woods.

From May to September, monsoons from the southwest bring up to 25 centimetres of rain a month. Temperatures average about 28 °C during that period. From November to March, rainfall averages less than 2.5 centimetres a month, and temperatures average 21 °C.

Economy. Laos has an underdeveloped economy. Its mineral resources have not been developed, and the country has few manufacturing industries. Agriculture is the chief economic activity. But old-fashioned farming equipment and methods hold down the country's agricultural output. Rice is the chief product of Laos. Other farm products include coffee, maize, cotton, tobacco, and livestock. Some Laotians grow and export opium.


© Blair Seitz, Photo Researchers

Farmers in Laos live mainly in fertile river valleys. Rice is the chief crop. Coffee, maize, and cotton are also grown. In addition, most farm families have vegetable gardens, *above.*

The Mekong River and its tributaries are the chief means of transportation in Laos. Most roads are passable only in the dry season. In many areas aeroplanes are the only means of moving supplies. Laos has no railways, but a railway line links Nong Khai—across the Mekong River from Vientiane—with Bangkok, Thailand.

History. Ancestors of the Lao and Tai probably moved into Laos in the A.D. 800's. They set up small states ruled by princes. In 1353, the ruler of Muong Swa (now Louangphrabang) united most of what is now Laos in the kingdom of *Lan Xang* (land of a million elephants). About 1700, three separate kingdoms—Louangphrabang, Vientiane, and Champasak—were formed. In the late 1800's, France made Laos a protectorate and ruled it as part of Indochina. See **Indochina.**

A Free Laos committee, headed by brother princes Phetsarat, Souvanna Phouma, and Souphanouvong, negotiated Laos's first constitution in 1947 with France. Independence within the French Union came in 1949. The princes then split into rival factions, and Souphanouvong moved to northeastern Laos. There he made contact with Ho Chi Minh, the North Vietnamese Communist leader, and set up the Communist-inspired Pathet Lao movement.

Ho Chi Minh's forces defeated the French at Dien Bien Phu in Vietnam in 1954. A peace conference at Geneva, Switzerland, then established Laos as a neutral country, a "buffer" between Communist North Vietnam and non-Communist Thailand (see **Geneva Accords**). Laos became a member of the United Nations in 1955. A series of governments ruled Laos from 1954 to 1960.

In 1960, Captain Kong Le, a Laotian army officer, overthrew the pro-Western government and demanded a neutralist government. Civil war soon broke out. Kong Le and the Pathet Lao seized control of most of northern Laos before a cease-fire was declared in 1961.

But fighting continued, and in 1962, a 14-nation conference at Geneva set up a coalition government in Laos. Prince Souvanna Phouma, a neutralist, became prime minister. Prince Boun Oum, an anti-Communist, and Prince Souphanouvong, a Communist, were made cabinet ministers. The agreement ordered foreign troops out of Laos and guaranteed Laos's neutrality under the supervision of an International Control Commission.

In 1963, Souphanouvong withdrew from the government. Fighting broke out again between the Pathet Lao and government forces. The Pathet Lao received support from Chinese and Soviet military advisers and thousands of North Vietnamese troops. The Laotian government was backed by troops from Thailand and South Vietnam, and military advisers from the United States. By 1970, Souvanna Phouma's government troops controlled only western Laos. Pathet Lao forces, led by Souphanouvong, held eastern Laos.

During the Vietnam War, North Vietnam used the Ho Chi Minh Trail in Laos and Cambodia to move troops and supplies into South Vietnam. United States planes bombed the trail and other areas in Laos. In 1971, South Vietnamese troops, supported by United States bombers and helicopters, entered Laos to attack Communist supply routes. However, Communist forces drove them out.

In 1973, the Laotian government and the Pathet Lao agreed to a cease-fire and to the formation of a coalition government. A new government was set up in 1974, with Souvanna Phouma as prime minister and Souphanouvong as head of an advisory body. In 1975, pro-Communist demonstrations occurred, and many non-Communist government officials resigned and were replaced by Communists. The government came under Communist rule. At the same time, the Pathet Lao took over large amounts of land.

The Vietnam War ended in April 1975, when South Vietnam fell to the Communists. Communists also won control of Cambodia that month. Later in the year, the king gave up his throne and the Pathet Lao took over Laos. The country became a Communist state. Since the Communist take-over, thousands of Laotians have fled the country. Since shortly after the take-over, about 50,000 Vietnamese troops have been stationed in Laos. The Vietnamese have much influence over the Laotian government. Souphanouvong held the largely honorary post of president in the Communist government from 1975 until he retired in 1986.

See also **Louangphrabang; Vientiane; Southeast Asia; Colombo Plan; Mekong River; Vietnam War.**

Laozi, according to legends, wrote the *Laozi,* one of the basic books of the Chinese philosophy called *Taoism,* also spelled *Daoism.* This book is often called the *Tao Te Ching (The Classic of the Way and the Virtue).* Laozi's name is also spelled *Lao Tzu.*

Unreliable accounts say that Laozi lived during the 500's B.C. However, the *Tao Te Ching,* made up of 81 brief sections, was probably compiled and revised during the 200's and 100's B.C. More than half its sections are in rhyme. The remainder of the book includes popular sayings and Taoist teachings in prose.

The *Tao Te Ching* describes the *Tao* (Way), the unity of nature that makes each thing in the universe what it is and determines its behaviour. This unity can be understood only by mystical intuition. The book teaches that, because yielding eventually overcomes force, a wise man desires nothing. He never interferes with what happens naturally in the world or in himself. One passage says: "The highest good is like water. Water excels in giving benefit to all creatures, but never competes. It is found in places that most men despise, and so comes closest to the Tao." The *Tao Te Ching* also teaches that simplicity and moving with the flow of events are the keys to wise government.

See also **Taoism; Zhuangzi.**

Laparoscopy is a surgical technique used to examine organs and to detect and treat certain diseases within the abdomen. Doctors use an instrument called a *laparoscope* to perform this technique. The laparoscope is a metal tube with lenses, an illumination system, and a channel for surgical instruments. It is inserted into the abdomen through a small opening made in the abdominal wall. The doctor can observe the liver, gall bladder, spleen, and, in a woman, the reproductive organs. Laparoscopy allows doctors to detect cirrhosis or cancer of the liver, and disorders of other abdominal organs and the lining of the abdominal cavity.

Surgeons can treat certain diseases by passing special instruments through the laparoscope and moving them in the abdomen. For example, doctors can use this technique to remove the gall bladder (see **Gall bladder**). Surgeons also use the laparoscope to perform *laparoscopic sterilization,* an operation that prevents pregnancy in women. This procedure cuts or destroys a portion of the woman's Fallopian tubes or blocks the tubes.

La Paz (pop. 976,800) is the largest city and chief commercial centre of Bolivia. It also serves as the country's actual capital. The official capital is Sucre, but almost all government agencies are in La Paz. La Paz is the highest capital in the world. It lies about 3,660 metres above sea level. The city covers the slopes, and part of the bottom, of a canyon in the *altiplano* (high plateau) region of western Bolivia. Snow-capped peaks of the Andes Mountains overlook the city. For location, see **Bolivia** (map).

Aymara Indians make up about half the population of La Paz. Many of them live on the upper terraces of the canyon in adobe huts with corrugated iron or red tile roofs. Farther down both sides of the canyon are modern skyscrapers and government buildings. The centre of city life is the Plaza Murillo, a garden square. The Legislative Palace, a cathedral, and other large buildings face the plaza. At the bottom of the canyon is a residential section of modern houses. There, many of the city's whites and *mestizos* (people of mixed ancestry) live.

La Paz has a large market where Indians sell flowers, fruit, meat, vegetables, and such handmade products as *serapes* (shawls) and blankets. Institutions of higher learning in the city include the Higher University of San Andres and the Bolivian Catholic University.

La Paz has a high unemployment rate. The Bolivian government employs about half the people who have a job. Importing and exporting companies are the city's most important businesses. La Paz has few large factories. The chief manufactured products include beer, canned food, cement, glass, and textiles.

Spanish settlers led by Alonso de Mendoza founded La Paz in 1548 on the site of an Aymaran Indian village. The town grew steadily because it lay on the route used to transport silver from rich mines in southeastern Bolivia to the Pacific coast. In 1899, most of Bolivia's government agencies moved from Sucre to La Paz. Since then, La Paz has been both the governmental and commercial centre of Bolivia. The city has grown especially rapidly since the early 1950's. Its population has about tripled since that time.

La Pérouse, Jean François (1741-1788), was a French navigator who sailed into Botany Bay, Australia, only six days after Arthur Phillip arrived in the bay with the First Fleet to establish a colony there (see **Phillip, Arthur**). La Pérouse entered Botany Bay on Jan. 26, 1788.

La Pérouse arrived at Botany Bay near the end of a scientific voyage of exploration. Equipped with two scientific research vessels, the *Boussole* and *Astrolabe,* La Pérouse had left France in August 1785 and explored Easter Island, Hawaii, Alaska, the west coast of America, China, Siberia, and the Pacific.

La Pérouse was born near Albi in France. The Sydney suburb of La Pérouse is named after the explorer.

Lapidary is the cutting and polishing of gems. The word *lapidary* also refers to a person who does this type of work. Professional lapidaries flourished in Assyria, Babylonia, and Egypt more than 6,000 years ago.

Gems may be cut in several ways. For example, lapidaries cut some stones in a style called *cabochon,* with a rounded top and a flat bottom. Many gems, such as dia-

A stone is polished on a lapidary wheel, *right.* The picture on the left shows how a piece of dolomite looks before and after shaping and polishing. The lapidary cuts the stone into an oval shape with a diamond saw and then grinds and polishes it.

monds, are cut so they have numerous flat, polished *facets* (surfaces). Lapidary also includes the carving and engraving of gems.

Professional lapidaries have traditionally kept their methods secret. During the 1920's in the United States, several men who collected gems as a hobby decided to learn how to cut and polish their own stones. They built equipment and developed techniques by trial and error. Amateur lapidary soon became a popular hobby. Today, there are many amateur lapidary clubs.

See also **Diamond; Gem.**

Lapis lazuli is a beautiful azure-blue stone used as an ornament. It consists chiefly of *lazurite,* a mineral composed of sodium, aluminium, silicon, oxygen, and sulphur. Most lapis lazuli also contains such minerals as calcite, pyrite, and sodalite. Small amounts of yellow pyrite help to identify the stone as genuine lapis lazuli. But the presence of white calcite generally lowers the value of lapis lazuli. Large deposits of lapis lazuli are found in the Hindu Kush mountains of Afghanistan and at the southwestern end of Lake Baikal in Russia.

Lapis lazuli has been used in jewellery since ancient times. The tomb of King Tutankhamen, who ruled Egypt during the 1300's B.C., contained many objects made of gold and lapis lazuli. Ancient peoples believed that lapis lazuli had medicinal value. They ground the stones to a powder, which was mixed with milk. The mixture was used as a dressing for boils and ulcers. Lapis lazuli was once ground to produce *ultramarine,* a blue pigment used in paintings.

See also **Gem** (picture).

Laplace, Marquis de (1749-1827), a French astronomer and mathematician, became famous for his theory regarding the origin of the solar system. In his *Exposition of the System of the World* (1796), he started with a theoretical primitive nebula. He believed that this huge, lens-shaped cloud of gas rotated, cooled, contracted, and threw off planets and satellites. The remaining matter formed the sun. Laplace's nebular hypothesis was accepted for a long time, but has now been replaced by other theories. However, scientists still have not solved the problem. See **Earth** (How the earth began).

In 1812, Laplace published his *Analytic Theory of Probability.* A second edition of this work was prefaced by *A Philosophical Essay on Probability* (1814), intended for the general reader. Laplace also contributed studies in mathematical astronomy. In *Celestial Mechanics* (1798-1825), he summed up the achievements in theoretical astronomy from the time of Newton.

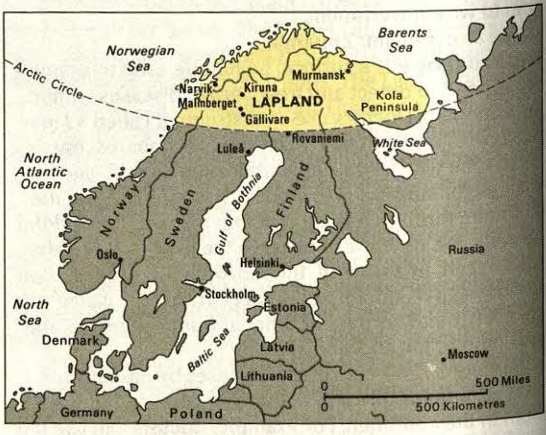
Laplace was born Pierre Simon Laplace at Beaumont-en-Auge, France. He became a professor of mathematics in Paris at the age of 20.

Lapland lies in the extreme northern part of Europe, above the Arctic Circle. The region is called Lapland because it is the home of a people known as Lapps. Lapps call themselves *Sami.* Lapland does not form a separate country. The region that makes up Lapland belongs to Norway, Sweden, Finland, and Russia.

Lapland has a cold climate. Winter generally lasts from October to May. During winter, lakes and rivers are frozen and the land is covered with snow. Winter temperatures fall as low as −18° C at the coast and −43° C inland. In the summer, temperatures rise as high as 21° C at the coast and 27° C inland. Because Lapland lies so far north, it has a period of two months in summer when the sky never darkens, and two months in winter when the sun never rises above the horizon.

Location and size. Lapland covers about 388,000 square kilometres. The region stretches across the northern parts of Norway, Sweden, and Finland, and also a small section of northern Russia. Lapland has no definite boundary to the south, but it ends approximately at the Arctic Circle.

The land and its resources. Most of Lapland is a bleak, barren region with stunted trees and thin vegetation. However, some areas have extensive forests of birch, pine, and spruce. Most trees are kept small by the cold climate. Other plant life includes shrubs and berry bushes. Mosses and lichens are an important food for reindeer. Some reindeer wander wild, but many others are herded like cattle. The reindeer provide an important source of food, and also serve as draught and pack animals. Some Lapps cultivate barley, hay, and potatoes.



Lapland's southern border lies at about the Arctic Circle, so the region's climate is one of extreme cold.

A Lapp bride and groom wear traditional costumes for their wedding. Lapps dress in reindeer skins and colourful woollens.

Iron ore and nickel are Lapland's most valuable mineral resources. Beds of iron ore lie deep under the soil of southern Swedish Lapland. The nickel deposits are in the Russian part of the region. Lapland's iron ore deposits rank among the largest in the world. Gällivare, Kiruna, and Malmberget have some of the world's richest iron ore mines. Railways link the iron ore fields with Narvik, Norway, on the Norwegian Sea; and with Luleå, Sweden, on the Gulf of Bothnia. The railways carry iron ore to these ports for export to other countries. Murmansk, in Russia, is an important fishing port.

The people and their work. Lapland has about 1$\frac{1}{2}$ million people, but only about 45,000 of the people are Lapps. About 20,000 of these Lapps live in Norway, about 17,000 in Sweden, about 4,400 in Finland, and about 1,500 in Russia.

The Lapps are among the smallest peoples of Europe. They average only about 150 centimetres in height. Many have low foreheads, high cheekbones, broad and flat noses, straight dark hair, and slightly dark skin. Many Lapps have married Swedes, Finns, or Norwegians.

Traditional Lapp clothing is made of wool and reindeer fur trimmed with bright cloth. Most Lapps only wear traditional clothing for special occasions. They usually wear Western-style clothing.

The Lapps were once mostly a nomadic people who followed reindeer herds. Some still follow this way of life. But most Lapps now live in fishing or farming villages. Some Lapps live and work in cities.

Lapps who live in rural areas may be grouped according to their primary means of livelihood. These groups are (1) the Sea Lapps, (2) the Mountain Lapps, and (3) the Forest Lapps.

Sea Lapps, the largest group of Lapps, live along the coast. They earn their livelihood primarily by fishing. The Sea Lapps often build their houses in groups to form fishing communities.

Mountain Lapps rear reindeer for a living. They are mostly young men. They live north in summer, and move south with their reindeer in winter. Some live in cabins. Others travel with modern camping equipment. They rear reindeer mainly to be sold as meat.

Forest Lapps live in villages in wooded areas. Many work as loggers. Some farm for a living or rear reindeer, beef cattle, or sheep. Forest Lapps who live on the shores of rivers or lakes also fish. These Lapps are sometimes called *River Lapps.*

Language and religion. The language of the Lapps is related to that spoken in Finland. The people in various areas speak sharply different dialects. Norway, Sweden, and Finland offer schooling in the Lapp language. Lapland has some institutes for the advanced study of Lapp culture.

All Lapps once practised a form of religion called *shamanism.* The Lapp *shaman* (medicine man) is best known for beating drums to foretell the future. Today, most Lapps belong to the Lutheran or Eastern Orthodox churches. People often have trouble attending services because they live so far from church. But they will cross vast distances to be married or to bury their dead.

History. Anthropologists believe that the Lapps moved to Lapland from northern Asia thousands of years ago. The Vikings began to trade with the Lapps before A.D. 1000. At that time, the Lapps occupied almost all of Finland and the northern regions of Norway and Sweden. Later, Finnish settlers moved northward, pushing the Lapps into northern Finland. Starting in the

Reindeer are the chief means of livelihood for many Lapps. The animals provide meat and milk for food and hides for clothing and tents. This Lapp is leading his herd on a spring migration.

Mountain Lapps are a nomadic people, moving constantly in search of food for their herds of reindeer. Each Mountain Lapp family lives in a portable cone-shaped tent called a *lavo.*

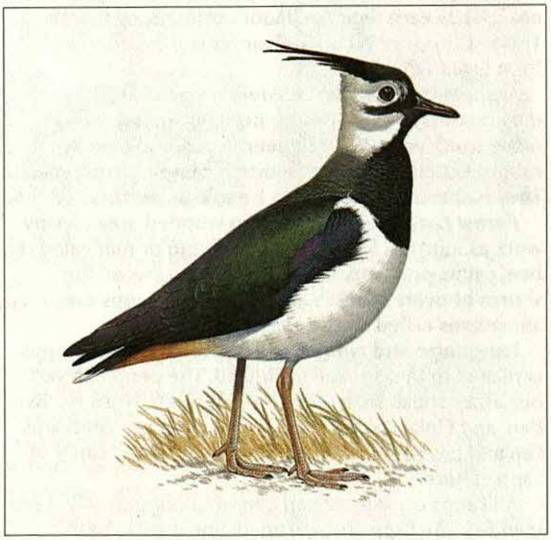
1500's, the Lapps fell under the control of the governments of the countries that administer Lapland today.

Since the mid-1900's, an increasing number of Lapps have abandoned their traditional way of life to work in cities and large towns in or outside of Lapland. Many Lapps have urged their governments to help preserve Lapp customs, language, and life style.

See also **Sweden** (People); **Clothing** (picture: Lapp family).

La Plata, Río de. See **Río de la Plata.**

Lapps. See **Lapland.**



The lapwing has a crest that ends in a pointed peak. The bird lives in western Europe. It lures enemies away from its nest by pretending to be injured.

Lapwing is a crested bird that lives in western Europe. The lapwing's name comes from the awkward way it flaps its wings as it flies. The bird is also called a *peewit* because of its shrill, wailing cry. The lapwing has a bronze-green back and a blue-black throat and breast. Its crest is long and pointed. When the lapwing's nest is threatened, it limps and pretends to be hurt and lures its enemies away.

Scientific classification. The lapwing belongs to the family Charadriidae. It is *Vanellus vanellus.*

Lara, Brian (1969-), a West Indian cricketer, made cricket history with a record-breaking test score. In April 1994, playing for the West Indies against England in Antigua, he scored 375 runs. This score broke the previous record of 365, made by West Indian cricketer Gary Sobers in 1958 (see **Sobers, Sir Garfield**). Soon after making his test-match record, Lara joined the English county cricket team, Warwickshire. Batting for Warwickshire against Durham in June 1994, he made another record with a score of 501 not out, the world's highest first-class innings. The record had been held since 1959 by Pakistani batsman Hanif Mohammad, with a score of 499.

Brian Lara

Brian Charles Lara was born in Santa Cruz, Trinidad. At the age of 18, he captained the West Indies under-23 team. In 1991, he played in his first test match, for the West Indies against Pakistan.

Larache (pop. 63,893) is a seaport on the northern Atlantic coast of Morocco (see **Morocco** [map]). The city is an important fishing and agricultural centre. The city was founded in the 800's. Portugal occupied the city briefly during the 1400's. Spain ruled Larache during the 1600's. The city was taken by the Moroccan sultan in 1689. Larache was under Spanish control from 1912 until Morocco became independent in 1956.

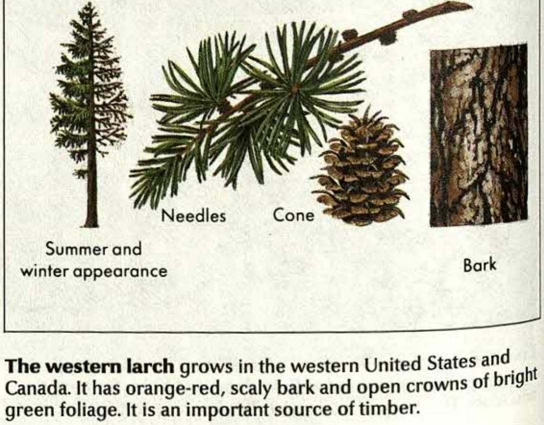
Larch is a tree that belongs to the pine family. Unlike most trees that have needlelike leaves, larches shed their needles every autumn. Such trees are called *deciduous* (see **Tree** [Cone-bearing trees]).

Larches grow throughout the Northern Hemisphere. Their needles grow in clusters on spurlike branches. Cones grow from some of the buds. Ripe cones are about 2 centimetres long. At first, they are a bright red. Then they turn dark red. When ripe, they become chestnut-brown. The cones remain on the trees after the needles have fallen off. Larches are commonly planted as ornamental trees because of their attractive shape and their open, yellow-green crowns.

European larch, or *common larch,* is native to the mountainous parts of central Europe. It is also widely grown in other countries, mainly for its strong timber, but also as an ornamental tree in parks and gardens. It grows up to 40 metres tall. Its bark is grey or grey-pink, cracked and scaly.

Japanese larch comes originally from Japan, but is commonly grown elsewhere for its timber. It grows faster than the European larch, and is more resistant to diseases. It grows up to 30 metres tall, and has dark red-brown cracked or scaly bark.

Western larch is native to the northwestern United States and south west Canada. It is also grown in other parts of the United States and in Europe for its timber, which has many uses. It is a large tree, growing up to 45 metres tall. It has an orange-red, scaly bark, and open



The western larch grows in the western United States and Canada. It has orange-red, scaly bark and open crowns of bright green foliage. It is an important source of timber.

crowns of light green foliage. The wood of the western larch closely resembles that of the Douglas fir.

Scientific classification. Larches are in the pine family, Pinaceae. They make up the genus *Larix.* The European larch is *L. decidua.* The Japanese larch is *L. kaempferi.* The western larch is *L. occidentalis.*

See also **Conifer; Deciduous tree; Evergreen; Pine.**

Lard is a solid or semisolid fat obtained by melting the fatty tissues of pigs. Fat from the pig is *rendered* (melted) and strained to remove any bits of flesh or tissue. The lard is then cooled in containers or in firm white blocks, which are later cut into bricks and packaged for sale in shops.

The finest lard comes from the fat around the kidneys of the pig. This lard is the best lard to use for cooking. When it is fresh, good lard has a mild flavour and a pleasant odour. Good lard is light and almost crumbly.

Lard is a *triglyceride*—that is, a compound formed by an alcohol called *glycerol* and three fatty acids. The acids in lard are oleic acid, palmitic acid, and stearic acid. Lard can be broken down into substances that have important commercial uses. Olein is an oily substance used as a lubricant, as a burning oil, and in the manufacture of margarine. Palmitin is used to make soap and candles. Stearin is used in the manufacture of soap, ointments, and some kinds of margarine.

Lardner, Ring (1885-1933), was an American journalist who achieved fame as the author of satirical short stories. Lardner wrote his best stories in the language of lower middle class Americans. The language included grammatical errors, misspellings, and the comical misuse of words. Many of the stories are told by a semiliterate narrator. Lardner's style exposes the lack of culture, inadequate self-knowledge, and selfishness of his characters. At the same time, his best stories are minor masterpieces of humour. Lardner produced three volumes of skilful stories out of the 19 books he wrote. The collections are *How to Write Short Stories (with Samples)* (1924), *The Love Nest* (1926), and *Round Up* (1929).

Lardner was born into a wealthy, cultured family in Niles, Michigan. His full name was Ringgold Wilmer Lardner. He began his career as a reporter from 1905 to 1907. He then held several jobs at newspapers in Boston, Chicago, and St. Louis, leading up to his writing a highly regarded column called "In the Wake of the News" for the *Chicago Tribune* from 1913 to 1919. Lardner helped write two plays, *Elmer the Great* (1928) and *June Moon* (1929). He also contributed sketches and song lyrics to several musicals.

Lares and penates were patron spirits of the home in the religion of ancient Rome. Each household had its protective lar. The penates protected the household supplies. The lar was thought to be the spirit of an ancestor. Beginning in the last century before the birth of Christ, households included two lares. Lares were statuettes of young men in caps and tunics. They were kept in a sacred cupboard called the *lararium* in the entrance hall, or they were painted on a wall. The family made offerings to them after the evening meal.

Every block of houses in Roman cities had its own lar. Romans worshipped these lares at the Festival of the Compitalia, held on January 3. Rome also had its own public lares to protect it from enemies.

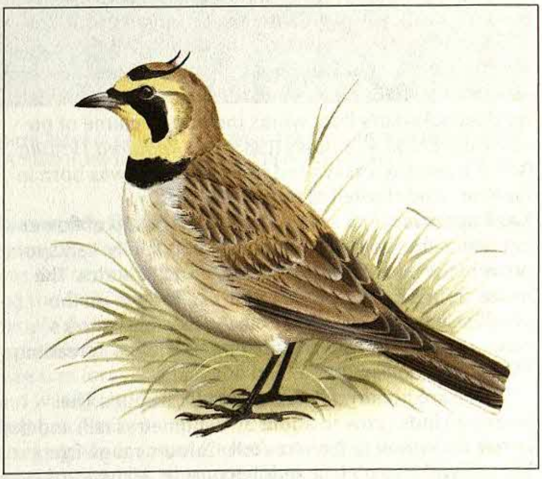
See also **Vesta.**

Lark is a type of small songbird found mainly in Europe, Asia, and Africa. There are about 75 species of lark worldwide. Only the *bushlark* is native to Australia. The only true lark of North America is the horned lark, known as *shore lark* in the Old World. The common *skylark* of Europe, North Africa, and Asia has been introduced to both Australia and North America.

Larks measure between 10 and 20 centimetres in length. They can be brown, or grey above, and most are paler with light spots beneath. In some species, the colour of the back varies widely and matches the soil colour of the region in which the birds live. For example, *crested larks* that live on the dark, fertile soil of the Nile Delta in northern Africa have dark brown, almost black, backs. Crested larks that live in the sandy deserts of Tunisia have pale tan backs, and those that live on reddish soils in Libya have cinnamon-coloured backs.

Many larks have a small *crest* (tuft of feathers) on their heads. When erect, the tufts resemble tiny horns. Unlike most songbirds, larks have a long rear toe with a claw that is almost straight.

Larks live in open country, such as deserts, fields, grasslands, and tundras. They spend most of their time on the ground and are good runners. Larks are famous for their song, which they often give while in flight. The male *skylark* begins singing while fluttering upwards. He continues his clear, loud song for as long as ten minutes while he glides into the wind, high above the ground. The song ends when the lark descends, first gently, then quickly with folded wings.



The shore lark of Europe and Asia is known as the horned lark in North America.

Most larks eat seeds and insects. On the ground, they build cup-shaped nests out of grass, hair, or pebbles. Females lay two to seven eggs, which vary in colour from one species to another and are spotted. The young hatch after 11 to 14 days.

Meadowlarks live in North America but are not true larks. They are members of the blackbird family (see **Meadowlark**).

Scientific classification. Larks make up the family Alaudidae. The bushlark is *Mirafa javanica.* The shore lark is

Eremophila alpestris. The skylark is *Alauda arvensis.* The crested lark is *Galerida cristata.*

Larkin, James (1876-1947), was an Irish trade union leader and political leader who helped to organize a general strike in Dublin in 1913.

Larkin created the Irish Transport and General Workers Union (ITGWU) in 1909, after leaving the British National Union of Dock Labourers. The 1913 strike centred on the right of Dublin workers to belong to the ITGWU. The general strike was unsuccessful and many of the strikers afterwards signed documents renouncing their union membership. But, despite signing, many of them kept up their membership in secret.

On the outbreak of World War I in 1914, Larkin went to the United States. He remained there as a trade union organizer until 1923, when he returned to Ireland. Larkin took a seat in the Dáil (parliament) in 1937.

Larkin, Philip (1922-1985), became a leading figure in the anti-romantic movement that dominated English poetry in the mid-1900's. The dominant theme of his work is the poet's isolation from a society that he feels to be mechanically misguided, but which he cannot change. Larkin's first collection of poems, *The North Ship* (1945), exhibited qualities of precise observation and unassertive technical control. In *The Less Deceived* (1955) and *The Whitsun Weddings* (1965), he developed these qualities to effect a richer and more densely metaphoric presentation. In 1965, he was awarded the Queen's Medal for Poetry. Larkin's later works include a volume of poetry called *High Windows* (1983) and *Required Writing* (1984), a book of essays and journalism. He was born in Coventry and studied at Oxford University.

Larkspur is the common name for a group of flowering plants that belong to the buttercup family. Larkspurs grow in Europe, Africa, Asia, and North America. The name comes from a curved, spurlike growth on the petallike base of each flower that resembles a lark's claw. The leaves are finely divided, the lobes spreading like fingers on a hand.

There are hundreds of species of larkspurs. The smallest kinds grow to about 30 centimetres tall, and the larger may grow to 2 metres tall. Colours range from blue or white to pink or reddish purple. All types of larkspur are very poisonous, both to people and animals, although sheep and horses are not so badly affected. Larkspur has been used for medicinal purposes.

Larkspur

Some American species have been introduced to Britain and Europe, where they are cultivated as garden flowers. Most grow easily because they do not require any special care. They do best in the open, in rich soil. Most larkspurs are planted from seed in the autumn or early spring, and flower in summer. They grow from an underground stem called a *rhizome* (see **Rhizome**). New plants may be grown from divisions of the rhizome, or from cuttings made from young shoots in the spring.

Larkspurs may become infected with a fungus disease called *sclerotium rot,* which yellows the leaves and makes the plant wilt. The disease can be controlled by removing the infected plant and by replacing the earth within a 45-centimetre radius. Larkspurs can also be infected by mildew.

Scientific classification. Larkspurs belong to the buttercup family, Ranunculaceae. They make up the genus *Consolida,* sometimes included in the genus *Delphinium.*

Larne (pop. 29,280), a local government district in Northern Ireland, is centred on the port and industrial town of Larne. Situated in the east of the province, the district consists of a low-lying coastal belt with a hilly hinterland. Farmers rear sheep on the hills and grow crops in the coastal regions. Ferries run from Larne to Stranraer and Cairnryan, in Dumfries and Galloway, Scotland, and to Fleetwood, in Lancashire, England. Carnlough and Island Magee are seaside resorts. Larne has engineering and textile production.

La Rochefoucauld, Duc de (1613-1680), was a French writer famous for his *Maxims* (1665). This work is a collection of about 500 sayings written to expose the vanity and hypocrisy the author saw underlying behaviour. For example, La Rochefoucauld wrote, "We always love those who admire us, but we do not always love those whom we admire," and "True love, however rare, is still more common than true friendship." The *Maxims* have been called pessimistic, but they really state in nonreligious terms a traditional Christian view of vice and weakness.

François de La Rochefoucauld was born into a noble family in Paris. In 1652, he was wounded fighting with the nobles against the French king Louis XIV in an unsuccessful revolt called the *Fronde.* La Rochefoucauld lived quietly after that, mainly writing.

La Rochelle (pop. 75,840), is a city on the west coast of France that is famous for its historical religious importance. Landmarks in the city include a scenic harbour, a town hall built in the 1500's, and the Cathedral of St. Louis, which dates from the 1700's.

La Rochelle was chartered as a city in the 1100's. In the 1500's, French Protestants were discriminated against by the country's Roman Catholic majority. But in 1598, the Edict of Nantes established 100 French communities, including La Rochelle, as areas of Protestant security. In 1627, the French government successfully returned the communities to its control.

Larva is an active, immature stage of an animal. It differs from the adult in such characteristics as structure, behaviour, food habits, and environment. An animal's development through egg, larval, and often pupal stages to the adult is called *metamorphosis.*

Larvae occur in the metamorphoses of many groups of animals. They are especially common in the insects and in animals that live in the water. The larva of the sponge is a tiny, oval creature that swims about by means of short, hairlike *cilia.* Eventually, it attaches itself to a solid object, and then develops into an almost immobile, adult sponge. Flukes, tapeworms, and roundworms usually have one or two parasitic larval stages.

Marine annelid worms have larvae called *trochophores* that swim about by means of cilia. Many molluscs, including mussels, oysters, scallops, snails, and

The mosquito larva looks transparent.

The blowfly larva resembles a small worm.

The green frog larva is called a *tadpole* or a *polliwog.* After hatching from an egg, the larva looks like a small fish and lives in the water.

The lacewing larva has many hairy spines, and large jaws with which it captures and eats insects.

The silkworm larva is called a *caterpillar.* Silk is made from the fibres of its cocoon. Unlike many larvae, it is useful to human beings.

periwinkles, have a free swimming larva called a *veliger.* Some of them also have another larval stage, a trochophore similar to that of the annelids. The larvae of freshwater mussels, called *glochidia,* fasten themselves to the gills or skin of fishes and ride about on them. Then they drop off, settle down, and burrow in the bottom. Many crustaceans, including lobsters and crabs, have active, free-swimming, large-eyed larvae. Barnacles have two distinct larval stages, called *nauplii* and *cyprids.* These larvae swim and drift great distances before fastening themselves to solid objects and becoming adults. The larvae of many water animals are important food for fishes. They float about as part of the mass of tiny, drifting aquatic organisms called *plankton.* (see **Plankton**).

Most insects have larvae more or less distinct from the adults. Larvae that undergo *incomplete metamorphosis* change directly to the adult stage. Such larvae are often called *naiads* if they belong to water insects. If they belong to land insects, they are called *nymphs.* The *caterpillar* of a moth or butterfly, the *grub* of a beetle, the *hellgrammite* of the North American insect, the dobsonfly, and the *maggot* of a fly are insect larvae with *complete metamorphosis.* Such insects pass through a pupal stage before becoming adults. Among the vertebrates, or animals with backbones, many fishes have distinct larvae. For example, eels have ribbon-shaped transparent larvae. Frogs and toads, which are amphibians, have larvae called *tadpoles.*

Related articles in *World Book* include:

Bee
Caterpillar
Fly
Frog
Grub
Hellgrammite
Leaf miner
Metamorphosis
Moth

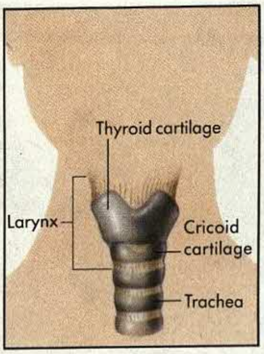
Larwood, Harold (1904-1995), was an English cricketer who played for Nottinghamshire and England. He was the central figure in the *bodyline* controversy during the MCC tour of Australia in 1932 and 1933. Some people thought that Larwood played unfairly, because he bowled fast and straight at each batsman. The batsman was forced to play the ball or risk being hit by it, and was likely to be out to a catch. Larwood played in 21 test matches.

Laryngitis is an inflammation of the tissues of the larynx, or voice box. It may be caused by various conditions. Sometimes infection invades the tissues and causes them to become inflamed. Doctors believe that laryngitis may result from the use of irritating materials, such as tobacco and alcohol. Breathing irritating substances may also inflame the larynx. Improper use of the voice, which puts extra strain on the larynx and the vocal cords, may frequently cause laryngitis.

When the inflammation begins, the tissues of the larynx swell. Soon the patient becomes hoarse. If the condition continues, use of the voice may be lost temporarily because the vocal cords become thick and cannot vibrate to produce sound. In severe cases, the swelling may inhibit the passage of air through the larynx. Most cases of laryngitis should be treated by a doctor.

Larynx is a section of the air passage in the throat. It is located between the back of the tongue and the *trachea* (windpipe). The larynx is sometimes called the *voice box,* because it contains the vocal cords. Every breath that passes into and out of the lungs passes through the larynx.

The larynx is shaped like a box, and it has a support-



The larynx has a framework of cartilage. The thyroid cartilage forms much of the front and side walls of the larynx.

ing structure made up of nine sections of cartilage. The thyroid cartilage, in front, and the cricoid cartilage, just below it, are the most important. The *thyroid cartilage* consists of two wing-shaped plates that meet to form the projection called the *Adam's apple.* These plates make up the sides of the larynx. The ring-shaped *cricoid cartilage* helps form the back wall of the larynx.

Voice production occurs in the space inside the larynx called the *glottis.* The *vocal cords,* two folds of elastic tissue, lie along the sides of the glottis. Small muscles in the vocal cords are attached to the glottis wall. These muscles can stretch the vocal cords, change their shape, or bring them close together. When the cords are close together, air rushing between them produces sound. The shape and tension in the cords determines the *pitch* (highness or lowness) of the voice. The shape of the throat, nose, and mouth determines the *quality* of a person's voice.

See also the Trans-Vision three-dimensional picture with **Human body**; also **Laryngitis**; **Voice.**

La Salle, Jean. See **Jean Baptiste de La Salle, Saint.**

La Salle, Sieur de (1643-1687), was a French explorer. He led the first European expedition to track the Mississippi River of North America to the Gulf of Mexico. La Salle claimed the entire Mississippi Valley for France. His many explorations strengthened France's hopes for a great empire in the New World.

Sieur de La Salle

Early life. La Salle was born in Rouen, France. His real name was René-Robert Cavelier. He took the name La Salle from the name of his family's estate. As a youth, La Salle went to schools run by Jesuit priests and studied to be a Jesuit. However, he left the religious training in 1665 to seek adventure. The next year, La Salle sailed to Canada, where France had established a colony.

La Salle obtained some land near Montreal and became a prosperous fur trader. He did much of his trading with Indians, who told him of two great rivers to the southwest, the Mississippi and the Ohio. In 1669, he sold his land and set out in search of the rivers.

First explorations. From 1669 to 1673, La Salle wandered through the vast interior of North America. Historians believe he travelled as far as what is now Ohio in the United States. By the end of his journey, La Salle was convinced the Mississippi emptied into the Gulf of Mexico.

La Salle returned to France in 1674, and King Louis XIV gave him land that included Fort Frontenac, on the site of the present city of Kingston, Ontario. La Salle established a fur trading post at the fort and soon became one of the most powerful people in Canada. In 1677, he again sailed to France, where he obtained permission from King Louis to explore the Mississippi River.

In 1679, after returning to Canada, La Salle launched an expedition to give France control of the Great Lakes region. The following year, he founded the first European settlement in what is now Illinois. It stood on the Illinois River, near present-day Peoria, and was named Fort Crèvecoeur (Fort Heartbreak). After La Salle built this fort, he went back to Canada for supplies.

Expeditions to the Gulf of Mexico. La Salle returned to the Illinois region in late 1681. Fort Crèvecoeur had been destroyed in a rebellion by some of its occupants, but La Salle pushed on. He led a party of about 20 Frenchmen and about 30 Indians down the Illinois River in canoes to the Mississippi.

The expedition started down the Mississippi River on Feb. 13, 1682, and reached the Gulf of Mexico on April 9. Near the mouth of the Mississippi, La Salle erected a cross and a column bearing the French coat of arms. He claimed all the land drained by the Mississippi and its tributaries for France. La Salle named the region Louisiana in honour of King Louis. In late 1683, he left for France to pick up supplies and settlers for such a colony.

In 1684, La Salle sailed from France for the Gulf of Mexico with 4 ships and over 300 colonists. But this expedition never reached the Mississippi because La Salle sailed past it by mistake. In 1685, he set up a colony, also called Fort Saint Louis, west of the river.

Indians threatened the new settlement, and many colonists died from disease. By 1687, the colony desperately needed help. La Salle and several men began an overland march to find the Mississippi, which they planned to follow to Canada. But they could not find the river. Some of the men rebelled and killed La Salle's nephew and then murdered La Salle.

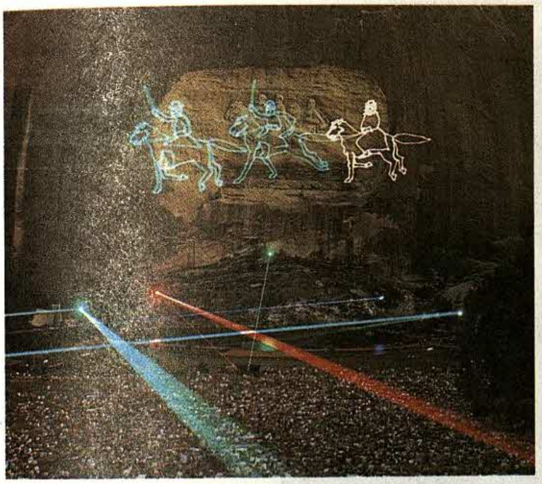
See also **Hennepin, Louis.**

Lascaux Cave. See **Cave** (table: Interesting caves of the world); **Painting** (picture).

Lasdun, Sir Denys (1914-), a British architect, achieved prominence for a wide range of buildings, including housing schemes, blocks of flats, shops, and university buildings. He designed Peter Robinson's store in the Strand, London; luxury flats in St. James's Place, London; Fitzwilliam College, Cambridge; the University of East Anglia; and the National Theatre, part of London's South Bank development.

Lasdun belongs to the school of architecture known as Modernism. At the outset of his career he was greatly influenced by the Swiss architect Le Corbusier (see **Le Corbusier**). Many of Lasdun's best-known buildings, such as the National Theatre, are of concrete.

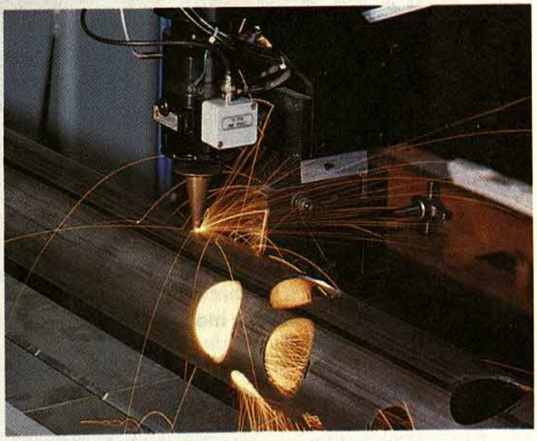
Denys Louis Lasdun was born in London. He was educated at Rugby School and at the Architectural Association. During World War II (1939-1945), he served with the Royal Engineers. Lasdun set up his own architectural practice in 1960. In 1962 and 1963, he held the position of professor of architecture at the University of Leeds. He was knighted in 1976.



Lasers create an image in a light show.

A doctor uses a laser to perform eye surgery.

A laser beam scans a bar code in a supermarket.



A powerful laser beam cuts steel tubing.

Laser beams have special properties that enable them to perform a variety of functions. They are narrow, they spread little, and they can be focused very precisely. The photographs above illustrate some of the many uses of lasers.

Laser

Laser is a device that produces a very narrow, powerful beam of light. Some beams are thin enough to drill 200 holes on a spot as tiny as the head of a pin. The ability to focus laser light so precisely makes it extremely powerful. For example, some beams can pierce a diamond, the hardest natural substance. Others can trigger a small nuclear reaction. A laser beam also can be transmitted over long distances with no loss of power. Some beams have reached the moon.

The special qualities of laser light make it ideal for a variety of applications. Some types of lasers, for example, are used to play music, read price codes, cut and weld metal, and transmit information. Lasers can also guide a missile to a target, repair damaged eyes, and produce spectacular displays of light. Still other lasers are used to align walls and ceilings in a building or to print documents. Some lasers even can detect the slightest movement of a continent.

Lasers vary greatly in size. One is almost as long as a football field. Another type is as small as a grain of salt.

A typical laser has three main parts. These parts are (1) an *energy source,* (2) a substance called an *active medium,* and (3) a structure enclosing the active medium known as an *optical cavity.* The energy source supplies an electric current, light, or other form of energy. The atoms of the active medium can absorb the energy, store it for a while, and release the energy as light. Some of this light triggers other atoms to release their energy. More light is added to the triggering light. Mirrors at the ends of the optical cavity reflect the light back into the active medium. The reflected light causes more atoms to give off light. The light grows stronger, and part of it emerges from the laser as a narrow beam. Some beams are visible. Others consist of invisible forms of radiation.

There are four main kinds of lasers. They are solid-

Lasers vary greatly in size. Lasers used to concentrate power in nuclear energy research, *left,* fill a huge room. Tiny lasers, like the one shown in the centre among magnified grains of salt, *below,* are built to transmit messages as flashes of light.

state lasers, semiconductor lasers, gas lasers, and dye lasers.

In 1960, the American physicist Theodore Maiman built the first laser. At first, lasers had few uses, and scientists often thought of them as "a solution looking for a problem." Today, however, lasers are among the most versatile and important tools in modern life.

How lasers are used

Lasers can do a number of incredible things. Their special qualities make them particularly useful in recording, storing, and transmitting many kinds of information. Lasers also are valuable in such activities as scanning, heating, measuring, and guiding. As a result of their wide use, lasers can be found in equipment used in homes, factories, offices, hospitals, and libraries.

Recording, storing, and transmitting information. The most common uses of lasers include the recording of music, films, computer data, and other material on special discs. Bursts of laser light record such material on the discs in patterns of tiny pits. The discs with recorded music and computer data are called *compact discs* (CD's).

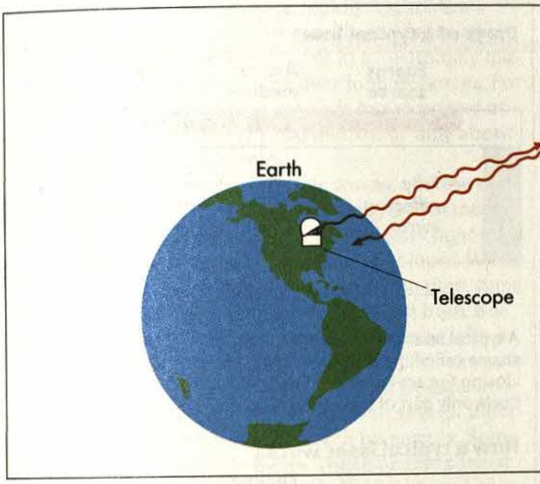
A laser beam's tight focus allows much more information to be stored on a CD than on a gramophone record, making CD's good for holding data as well as music. Some CD's even can hold an entire encyclopedia. A disc used for storing data is usually called a *CD-ROM* (Compact *D*isc *R*ead-*O*nly *M*emory). Such discs store *databases* (large files of information held in computers) and are used widely by businesses, libraries, and government agencies.

Lasers can also read and play back the information recorded on discs. In a CD player, a laser beam reflects off the pattern of pits as the compact disc spins. Other devices in the player change the reflections into electrical signals and decode them as music. More lasers are used in CD players than in any other product.

Lasers are used to record films on large platters called *videodiscs.* In addition, laser beams can produce three-dimensional images in a photographic process called *holography.* The images, recorded on a photographic plate, are known as *holograms.* They appear in advertising displays, artwork, and jewellery, and some are placed on credit cards to prevent counterfeiting.

One of the laser's greatest uses is in the field of *fibre-optics communication.* This technology changes electrical signals of telephone calls and television pictures into *pulses* (bursts) of laser light. Strands of glass called *optical fibres* conduct the light. An optical fibre is about as thin as a human hair. But one fibre can carry as much information as several thousand copper telephone wires. Laser light is ideal for this technology because it can be focused precisely and because all its energy can be introduced into the fibre. Fibre-optic transmission of laser light allows enormous amounts of telephone, TV, and other data to be communicated relatively cheaply.

Scanning involves the movement of a laser beam across a surface. Scanning beams are often used to read information. Many people have become familiar with laser scanners used at supermarket checkout counters. What looks like a line of light is actually a rapidly moving laser beam scanning a *bar code.* A bar code consists of a pattern of lines and spaces on packages that identifies the product. The scanner reads the pattern and sends the information to a computer in the supermarket. The computer identifies the item's price and sends the information to the register.



The distance to the moon is measured to an accuracy of 5 centimetres by a laser beam sent from the earth, *left.* The beam bounces off a laser reflector, *above,* placed on the moon by astronauts, and returns to the earth.

Many other kinds of stores use bar code scanners. In addition, such scanners keep track of books in libraries, sort mail in post offices, and read account numbers on cheques in banks. Laser printers use a scanning laser beam to produce copies of documents. Other scanners make printing plates for newspapers.

In entertainment, laser light shows are created with scanning laser beams. These beams can "draw" spectacular patterns of red, yellow, green, and blue light on buildings or other outdoor surfaces. The beams move so rapidly they produce what looks like a stationary picture. Laser scanners also produce colourful visual effects that create excitement at rock concerts.

Heating. A laser beam's highly focused energy can produce a great amount of heat. Industrial lasers, for example, produce beams of thousands of watts of power. They cut and weld metals, drill holes, and strengthen materials by heating them. Industrial lasers also cut ceramics, cloth, and plastics.

In medicine, the heating power of lasers is often used in eye surgery. Highly focused beams can close off broken blood vessels on the *retina,* a tissue in the back of the eyeball. Lasers also can reattach a loose retina. Laser beams pass through the *cornea* (front surface of the eye) but cause no pain or damage because the cornea is transparent and does not absorb light.

Doctors also use lasers to treat skin disorders, remove birthmarks, and shatter gallstones. Laser beams can replace the standard surgical knife, or scalpel, in some operations. The use of lasers permits extraordinary control and precision in cutting tissue and sealing off cuts. Thus, lasers reduce bleeding and damage to nearby healthy tissues.

In nuclear energy research, scientists use lasers to produce controlled, miniature hydrogen bomb explosions. They focus many powerful laser beams onto a pellet of frozen forms of hydrogen. The intense beams *compress* (pack down) the pellet and heat it to millions of degrees. These actions cause the pellet's atoms to *fuse* (unite) and release energy. This process, called *nuclear fusion,* may produce enough energy to solve the world's energy problems. Lasers have produced the tremendous heat needed to create fusion but have not yet produced usable amounts of energy.

Measuring. People also use lasers to measure distance. An object's distance can be determined by measuring the time a pulse of laser light takes to reach and reflect back from the object.

In 1969 and 1971, United States astronauts placed mirrored devices called *laser reflectors* on the moon. Using a high-powered laser, scientists measured the distance between the earth and the moon—more than 383,000 kilometres—to within 5 centimetres. They made the measurement by shining laser light from a telescope on the earth to the reflectors on the moon.

Laser beams directed over long distances also can detect small movements of the ground. Such measurements help geologists involved in earthquake warning systems.

Laser devices used to measure shorter distances are called *range finders.* Surveyors use the devices to get information needed to make maps. Military personnel use laser range finders to calculate the distance to an enemy target.

Guiding. A laser's strong, straight beam makes it a valuable tool for guidance. For example, construction workers use laser beams as "weightless strings" to align the walls and ceilings of a building and to lay straight sewer and water pipes.

Instruments called *laser gyroscopes* use laser beams to detect changes in direction. These devices help ships, aeroplanes, and guided missiles stay on course. Another military use of lasers is in a guidance device called a *target designator.* A person using the device aims a laser beam at an enemy target. Missiles, artillery shells, and bombs equipped with laser beam detectors seek the reflected beam and adjust their flight to hit the spot where the beam is aimed.

How a laser works

Parts of a laser. A typical laser has three main parts. These parts are an active medium, an energy source, and an optical cavity.

An active medium is a material that can be made to create laser light. Gases, liquids, or solid materials can be used.

An energy source is any type of device that supplies energy to the active medium in a process called *pump-*

ing. Lasers often use electricity, another laser, or a *flash lamp* as an energy pump. A flash lamp produces a bright flash of light, just as a camera flash does.

An optical cavity, also called a *resonator,* is a structure that encloses the active medium. A typical cavity has a mirror at each end. One mirror has a fully reflecting surface, and the other one has a partly reflecting surface. The laser beam exits the laser through the mirror with the partly reflecting surface.

The nature of atoms. Laser light results from changes in the amount of energy stored by the atoms in an active medium. The atoms of a substance normally exist in a state of lowest energy, called a *ground state.* Atoms also can exist in higher energy states, called *excited states.*

Atoms can change from a ground state to an excited state by absorbing various forms of energy. This process is called *absorption.* In many lasers, atoms absorb packets of light energy called *photons.* In most instances, the excited atom can hold the extra energy for only a fraction of a second before the atom releases its energy as another photon and falls back to its ground state. This process is called *spontaneous emission.*

Some atoms have excited states that can store energy for a relatively long time. These long-lived states can last as long as $\frac{1}{1,000}$ of a second—much longer than the duration of most excited states. When a photon of just the right amount of energy shines on an atom in a long-lived excited state, it can stimulate the atom to *emit* (give off) an identical photon. This second photon has an equal amount of energy and moves in the same direction as the original photon. This process is called *stimulated emission.*

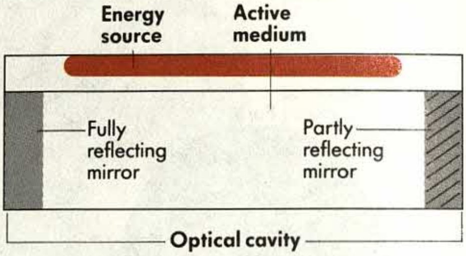
Producing laser light. Stimulated emission is the central process of a laser. One photon—the stimulating photon—produces another photon. It doubles the amount of light energy present, a process called *amplification.* The word *laser* comes from the first letters of the words that describe the key processes in the creation of laser light. These words are *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation.

Stimulated emission only occurs if there are atoms in the excited state. However, atoms in the ground state generally greatly outnumber those in excited states. For amplification to take place, more atoms of a substance must exist in excited states than in ground states. This condition is called a *population inversion.* In a laser, the energy source helps create a population inversion by pumping energy into the active medium. This energy places atoms in long-lived excited states and enables stimulated emission to occur. The mirrors in the optical cavity reflect the photons back and forth in the active medium.

Each interaction of a photon and an excited atom produces a chain reaction of stimulated emissions. This chain reaction causes the number of stimulated emissions to increase rapidly and produce a flood of light. Part of this intense light exits through the partly reflecting mirror as a strong beam.

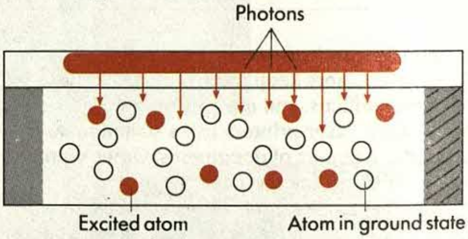
Characteristics of laser light. Laser light differs from ordinary light in two major ways. (1) It has low *divergence* (spreading). (2) It is *monochromatic* (single-coloured). Light with these two characteristics is known as *coherent light.*

Parts of a typical laser

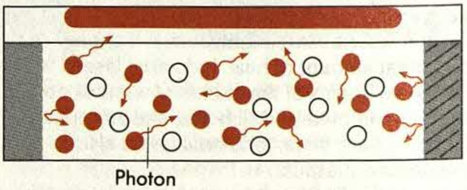


A typical laser has three main parts: an *energy source,* a substance called the *active medium,* and an *optical cavity* enclosing the active medium and two mirrors. One mirror reflects only part of the light striking it.

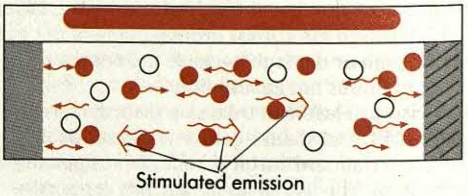
How a typical laser works



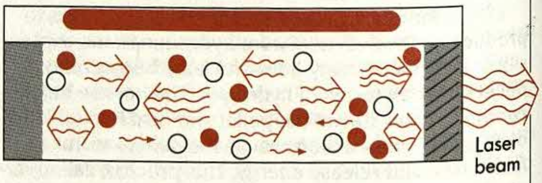
When the laser is turned on, the energy source gives off packets of light energy known as *photons.* Atoms absorb this energy, going from their *ground state* (state of lowest energy) to an *excited state.*



Excited atoms then give off photons. Some of this light reflects off the mirrors and remains in the cavity.



Some photons cause *stimulated emission:* A photon shining on an excited atom causes this atom to give off an identical photon that travels in the same direction.



Stimulated emission increases rapidly. The light becomes so strong that a small part of it exits through the partly reflecting mirror as an intense beam.

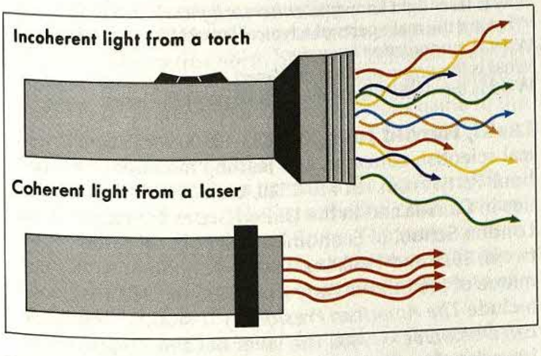
Most sources of light diverge rapidly. Light from a flashlight, for example, fans out quickly and fades after a short distance. But laser light travels in an extremely narrow beam. It spreads little, even over long distances. For example, a typical laser beam expands to a diameter of only 1 metre after travelling 1,000 metres, or only about 260 centimetres per kilometre.

Light consists of electromagnetic waves, and the colour of light is determined by its *wavelength* (distance from one peak of a wave to the next). Ordinary light consists of waves of many wavelengths—and colours. When all these waves are seen together at the same time, their colours appear white—like those from a light bulb. But light produced by most lasers consists of waves with a very narrow range of wavelengths. Because this range is so narrow, laser light appears to consist of a single colour. Some lasers can produce beams with several different colours, but each colour band will be narrow. Some lasers produce an invisible beam. These beams consist of such forms of radiation as ultraviolet or infrared rays.

Laser light is highly organized, or *coherent.* The waves of a laser beam move *in phase*—that is, all the peaks move in step with one another. These waves travel in a narrow path and move in one direction. Thus, coherent light is like a line of marchers in a parade moving with the same strides in the same direction. The waves of ordinary light, on the other hand, spread rapidly and travel in different directions. Ordinary light is known as *incoherent light.* Incoherent light acts much like the way people usually travel along a street—with different strides and in many directions. A laser beam's coherence allows it to travel long distances without losing its intensity.

Kinds of lasers

Most lasers can produce light either in a continuous beam or in pulses. The lasers that generate pulses, which are called *pulsed lasers,* supply all their energy in only a fraction of a second. As a result, they generally produce much greater peak power than lasers that produce a continuous beam, which are called *continuous-wave lasers.* Most continuous-wave lasers range in power from less than $\frac{1}{1,000}$ of a watt to more than 10,000 watts. But some pulsed lasers can produce beams of several trillion watts for a billionth of a second.



Lasers produce coherent light. Waves of coherent light, unlike waves of incoherent light, move "in step" with one another. As a result, they spread only slightly—even over great distances.

There are four main types of lasers. These types are (1) solid-state lasers, (2) semiconductor lasers, (3) gas lasers, and (4) dye lasers.

Solid-state lasers use a rod made of a solid material as the active medium. Substances made of crystals or glass are widely used. The most common crystal laser contains a small amount of the element neodymium (chemical symbol Nd) in an yttrium aluminium garnet (YAG) crystal. It is called an Nd:YAG laser. In some lasers, the neodymium is dissolved in glass. Flash lamps are generally used to pump the active media of solid-state lasers.

The world's largest and most powerful laser is an Nd:glass laser at Lawrence Livermore National Laboratory in Livermore, California, U.S.A. This laser, called Nova, is about as long as a football field. It produces laser light in pulses and is used for nuclear energy research. Its light is split into 10 beams, which are amplified to focus more than 100 trillion watts of power on a target for a billionth of a second.

Nd:YAG and Nd:glass lasers are used widely in industry to drill and weld metals. They are also found in range finders and target designators.

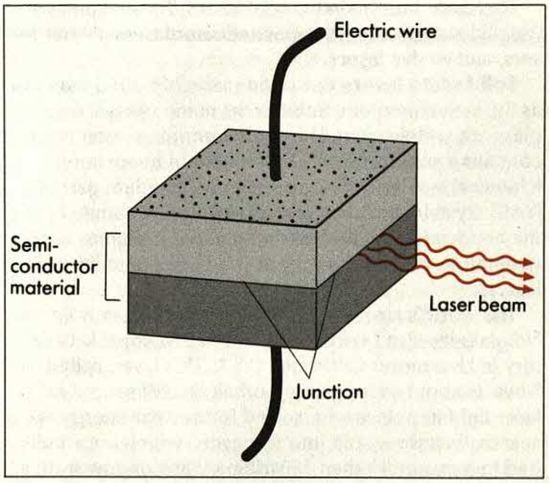
Semiconductor lasers, also called *diode lasers,* use semiconductors, which are materials that conduct electricity but do not conduct it as well as copper, iron, or other true conductors. Semiconductors used in lasers include compounds of metals such as gallium, indium, and arsenic. The semiconductor in a laser consists of two layers that differ in their electric properties. The junction between the layers serves as the active medium. When current flows across the junction, a population inversion is produced. Flat ends of the semiconductor materials serve as mirrors and reflect the photons. Stimulated emission occurs in the junction region.

Semiconductor lasers are the smallest type of laser. One kind is as tiny as a grain of salt. Another type is even smaller and can be seen only with a microscope. Semiconductor lasers are the most commonly used type of laser because they are smaller and lighter and use less power than the other kinds. Their size makes them ideal for use in CD and videodisc players and for fibre-optic communications.

Gas lasers use a gas or mixture of gases in a tube as the active medium. The most common active media in gas lasers include carbon dioxide, argon, krypton, and a mixture of helium and neon. The atoms in gas lasers are excited by an electric current in the same way that neon signs are made to light. Gas lasers are commonly used in communications, eye surgery, entertainment, holography, printing, and scanning.

Many gas lasers produce infrared beams. The most important one is the carbon dioxide laser. It is among the most efficient and powerful lasers. Carbon dioxide lasers convert 5 to 30 per cent of the energy from their energy source into laser light. Many other lasers convert only about 1 per cent of the energy they get. Carbon dioxide lasers can produce beams ranging from less than 1 watt to more than 1 million watts. They are often used to weld and cut metals. They also are used as laser scalpels and in range finders.

Dye lasers use a dye as the active medium. Many kinds of dyes can be used. The dye is dissolved in a liquid, often alcohol. A second laser is generally used to



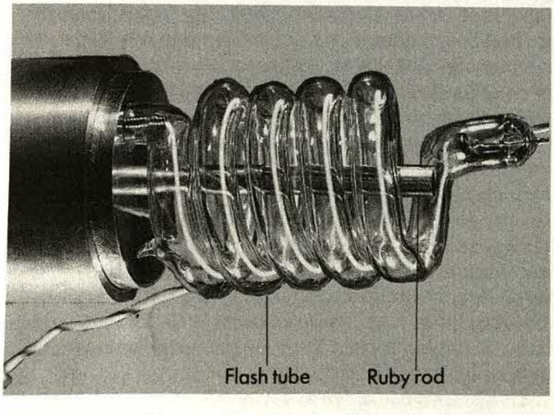
A semiconductor laser consists of two layers of material that differ electrically. Electric current passing through the layers produces laser light in the area of their junction.

pump the atoms of the dye. The most important property of dye lasers is that they are *tunable*—that is, a single laser can be adjusted to produce monochromatic beams over a range of wavelengths, or colours. Tunable lasers are valuable to researchers who investigate how materials absorb different colours of light.

History

Lasers were not invented before the 1900's chiefly because scientists did not know about stimulated emission. The process was first described in 1917 by the German-born physicist Albert Einstein. The next major advance in laser development came in 1954. That year, the American physicist Charles Townes created a population inversion in a device that amplified microwaves, an invisible form of radiation. The device was called a *maser* because it demonstrated *m*icrowave *a*mplification by *s*timulated *e*mission of *r*adiation.

During the late 1950's, researchers proposed designs for a device that would use stimulated emission to amplify light. Several people have received credit for developing the laser's basic design. They include Townes, American physicist Arthur Schawlow, the Russian physicists Alexander Prokhorov and Nikolai Basov, and the American inventor Gordon Gould.



The first type of laser, *above,* used a ruby rod as an active medium and a coiled flash tube as an energy source.

Theodore Maiman of the United States constructed the first laser in 1960. His laser used a ruby rod as its active medium. Later that year, the American physicist Ali Javan constructed the first gas laser. In 1962, three separate teams of U.S. scientists operated the first semiconductor lasers. In 1966, the American physicist Peter Sorokin built the first dye laser.

Advances in laser technology and uses have soared since the early 1970's. Today, the enormous information-carrying capacity of optical fibres is opening a new era in home entertainment, communication, and computer technology. Even so, researchers remain convinced that the most exciting and revolutionary uses of lasers still lie ahead.

Related articles in *World Book* include:

Bar coding
Bomb (Guided bombs)
Compact disc
Eye (Diseases of the retina)
Fibre optics
Glass (Speciality glasses)
Gyroscope (Laser gyroscopes)
Holography
Maser
Optical disc
Range finder
Videodisc

Outline

I. How lasers are used
- A. Recording, storing, and transmitting information
- B. Scanning
- C. Heating
- D. Measuring
- E. Guiding

II. How a laser works
- A. Parts of a laser
- B. The nature of atoms
- C. Producing laser light
- D. Characteristics of laser light

III. Kinds of lasers
- A. Solid-state lasers
- B. Semiconductor lasers
- C. Gas lasers
- D. Dye lasers

IV. History

Questions

What is the most important property of dye lasers?
What occurs in the process called *stimulated emission*?
Who built the first laser? When?
Why are semiconductor lasers the most commonly used lasers?
How are lasers used in medicine?
Why is laser light known as *coherent light*?
What are the main parts of a typical laser?
What is a *population inversion*?
What is the origin of the word *laser*?
What is the world's largest and most powerful laser?

Laski, Harold Joseph (1893-1950), was a British political scientist, educator, and leading member of the Labour Party. From 1914 to 1920, Laski lectured at universities in Canada and in the United States. He taught at the London School of Economics and Political Science between 1926 and 1950. Laski served on the executive committee of the Labour Party from 1936 to 1949. His books include *The American Presidency* (1940) and *The American Democracy* (1948). The latter became controversial because of its Marxist interpretation of American history. Laski was born in Manchester, England, and attended Oxford University.

Lasso, Orlando di (1532-1594), was a Flemish composer during the Renaissance. His name in Flemish was Roland de Lassus. Orlando di Lasso is the Italian version of his name. Lasso was one of the most productive and versatile composers of his time. He wrote about 500 unaccompanied choral works called *motets,* which are known for their dramatic and expressive qualities. Lasso's religious works include the Passion motet *Tristis est anima mea* and the *Seven Penitential Psalms.* His nonreligious music includes choral pieces with texts written in French, German, Italian, and Flemish. These pieces range from simple, light-hearted songs to large-scale works for multiple choirs.

Lasso was born in Mons, in what is now Belgium. In 1556, he settled in Munich, Germany, at the court of the Duke of Bavaria, becoming his music director in 1563.

Last Supper. See **Jesus Christ** (The Last Supper: picture); **Leonardo da Vinci; Holy Grail.**

Las Vegas (pop. 258,295; met. area pop. 741,459), the largest city in Nevada, United States, is famous for its gambling casinos and nightclubs. The city is a major tourist centre of the United States. Las Vegas lies in the southeastern corner of the state.

Las Vegas was founded as a station on what is now the Union Pacific Railroad route. The site consisted of fertile grassland, and the name of the city comes from two Spanish words meaning *the meadows.*

Nellis Air Force Base was established during World War II (1939-1945). The city's first big gambling casino opened in 1946. By the mid-1950's, gambling in Las Vegas had become a leading tourist attraction.

Lat (1951-) is the pen name of Mohamed Nor Khalid, a Malaysian cartoonist. He was born in Perak. At the age of 11, he produced comics for his school friends, drawn in pencil on folded-over drawing books. When he was 14, his first comic book was accepted by a Penang publisher. Before he left school, Lat was producing a cartoon series for the newspaper *Berita Harian* (Daily News). On leaving school, he worked as a crime reporter on the *New Straits Times.* For this newspaper he began, in 1974, to produce a cartoon series, "Scenes of Malaysian life," that established his name and popularity. His cartoons focus on the daily experiences of ordinary Malaysians. Many include Lat as a village boy or as a young man making his way in the modern city, with a mop of scruffy hair and a lop-sided grin. While sharply observing the peculiarities of Malaysian character, Lat's humour is gentle, never wounding.

Latakia (pop. 234,000) is Syria's main seaport. It lies about 177 kilometres north of Beirut, Lebanon (see **Syria** [map]). In the 1950's, Syria improved the port to make it useful to large ships. The city has given its name to the tobacco it exports.

La Tène style. See **Celts.**

Lateran is the common name for the Basilica of St. John Lateran in Rome. It is the cathedral church of the pope in his role as bishop of Rome. The name Lateran comes from Lateranus, the name of an ancient noble Roman family. The family's house stood on the site of the present church.

The original basilica was built on land donated by Emperor Constantine the Great in 313. The church was destroyed and rebuilt several times in the next 1,300 years. In the 1640's, architect Francesco Borromini remodelled the building in the baroque style, adding much of its elaborate interior decoration. The building owes much of its present appearance to Borromini's work. A new *facade* (front) was added in 1735. The church was extensively restored in the late 1800's.

Next to the basilica is the octagonal baptistery of St. John, a building in which baptisms were performed. The structure dates back to the time of Constantine. Also near the church is the Lateran Palace, which was the home of the popes from the 300's until 1305. The palace burned down in 1308 and was not rebuilt until the 1580's. It now houses church administrative offices. In 1929, the Lateran Treaty between Italy and the Roman Catholic Church made the three Lateran buildings part of the Vatican state.

Lateran Treaty. See **Papal States.**

Latex is a milky substance that serves as the source of natural rubber. It is produced by plants and trees of the sapodilla family. Most commercially used natural latex comes from hevea tree plantations of tropical Africa and Asia. Latex is obtained by cutting diagonal grooves in the bark of trees and gathering the material as it drips from these wounds. Because latex quickly decomposes, it must be processed within several hours after being collected. In some cases, it is thinned with water and treated with formic acid to make it *coagulate* (form solid particles). The particles are then rolled into sheets that are smoked and dried before shipping. The smoking kills bacteria and moulds that could rot the sheets.

See also **Rubber** (First uses; Natural rubber; Synthetic rubber); **Chicle; Guayule; Gutta-percha.**

Latham, Sir John (1877-1964), was deputy prime minister of Australia from 1931 to 1934 and chief justice from 1935 to 1952. John Greig Latham was born at Ascot Vale, Victoria. He studied law, and entered federal Parliament in 1922. After four years as attorney general, he became leader of the opposition, but stood aside to allow Joseph Lyons to become prime minister in 1931.

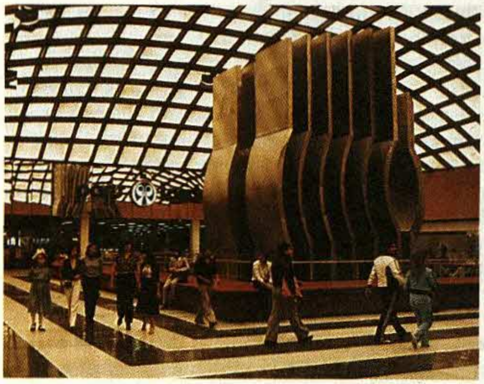
Latimer, Hugh (1485?-1555), was a martyr of the Protestant Reformation in England. Born in Thurcaston, England, he studied at Cambridge University and became a Roman Catholic priest. His refusal to condemn the views of Martin Luther concerning the church caused him to be called before Thomas Cardinal Wolsey in 1525 for investigation. But later he was named one of the clergymen who were to examine the legality of King Henry VIII's marriage with Catherine of Aragon. His support of Henry made him a favourite of the king, who named Latimer one of his chaplains. In 1535, after Henry had broken away from the Roman Catholic Church, Latimer became Protestant bishop of Worcester. But he resigned because he opposed the Six Articles, which he thought favoured Roman Catholicism.

Later, the Roman Catholic Queen Mary had him arrested with other Protestant churchmen. He was called before a church court and condemned to be burned at the stake. On Oct. 16, 1555, Latimer and Nicholas Ridley were brought to their place of execution opposite Balliol College, Oxford University. It is said that Latimer exclaimed, "We shall this day light such a candle, by God's grace, in England, as I trust shall never be put out." Latimer's martyrdom caused widespread sympathy for all persecuted Protestants.

Latin, language. See **Latin language.**

Copacabana Beach in Rio de Janeiro, Brazil

Coffee berry pickers in Costa Rica



A modern shopping mall near Mexico City

Farmland alongside Guatemala's Lake Atitlán

City and country life in Latin America contrast sharply. Many city dwellers live and work in sleek, modern buildings. Peasants in the countryside rent or own small plots of land or work on huge plantations. Many poor peasants have flocked to the cities looking for better jobs.

Latin America

Latin America is a large region that covers all the territory in the Western Hemisphere south of the United States. It consists of Mexico, Central America, South America, and the islands of the West Indies. The region is divided into 33 independent countries and 13 other political units. Brazil is by far the largest country in Latin America both in area and in population. It occupies more than 40 per cent of the region's land area and has about a third of its people.

During the late 1400's, people from southern Europe, especially Spain and Portugal, began to settle in Latin America. These people brought their own languages, religious beliefs, and customs with them. Over the centuries, their impact on the region was to be substantial. Today, the majority of Latin Americans speak Spanish, Portuguese, or French, each of which developed from Latin. For this reason, the region is called *Latin America*. English or Dutch is the official language in several areas of the region that were colonized by England or the Netherlands. Scholars disagree about whether such areas should be considered part of Latin America. This article includes these areas in its discussion of the region (see the table *Political units in Latin America*).

Before the first Europeans settled in Latin America, the region had been inhabited by American Indians. The Indians lived in the Americas for thousands of years before its European settlers. Soon after the Europeans arrived, they began to bring in many black Africans as slaves, especially to the West Indies and some mainland coastal areas. Over the centuries, numerous whites, Indians, and blacks intermarried. Today, most Latin Americans are of mixed ancestry. They are chiefly of Indian and white descent or of black and white descent. Most other Latin Americans are of unmixed Indian, black, or white ancestry.

The people of Latin America share many traditions and values that spring from their common colonial heritage. However, there are great local differences in the way of life throughout Latin America. Such differences largely reflect various combinations of the region's African, American Indian, and European cultural heritage.

Differences in the way of life also arise from differences in geography and in economic development from one part of Latin America to another. But even before the Europeans arrived, differences had arisen between the Indians of the highlands and the nomadic tribes of the lowlands.

Christopher Columbus, an Italian navigator in the service of Spain, reached Latin America in 1492. By that time, Indians had been living in the region for thousands of years. Such Indian groups as the Aztec, Inca, and Maya had developed highly advanced civilizations. The Europeans who followed Columbus to Latin America quickly conquered most of the Indians and established colonies. European rule of Latin America lasted about 300 years.

During the early 1800's, many Latin-American colonies gained their independence and became republics. However, the leaders of the new republics lacked the experience necessary to deal with serious social and economic problems. As a result, the new republics did not work as well as many people had hoped. In some Latin-American countries, military dictators seized control of the government. Other nations were ruled by a few powerful families who used their positions to increase their personal wealth. Antigovernment protests and violent revolutions occurred frequently throughout Latin America. During the 1900's, civilian and military leaders have tried to bring political stability to the region. But in the process, many of these leaders have restricted the people's civil rights.

Until the mid-1900's, the majority of Latin Americans lived in rural areas. Today, most of the people live in urban areas. The difficulty of growing enough food from the poor soil has led millions of rural people to seek work in the cities. However, many of these people are uneducated and unskilled. As a result, they cannot find jobs and so continue to live in wretched poverty. The widespread poverty, overpopulation, and violations of human rights all help to create political and social unrest in much of Latin America today.

This article discusses the people, way of life, arts, and history of Latin America. To understand the region more thoroughly, see the *World Book* articles on each of the independent countries and other political units in Latin America. See also **North America, Central America, South America,** and **West Indies.**

People

Population. Latin America has a population of about 482 million. The population is increasing about 2 per cent a year, making Latin America one of the fastest-growing regions in the world.

Latin America's population has almost quadrupled since 1940. The increase is due to a high birth rate and improvements in health care, which have led to a decline in the region's death rate. About a third of all Latin Americans are under 15 years old.

Latin America covers about 21 million square kilometres. If the population were evenly distributed throughout this enormous region, there would be only about 23 people per square kilometre. But the population is far from evenly distributed. Vast areas of the interior of South and Central America have few or no people. Much of the interior is covered by tropical rainforests. Some dry grasslands, desert areas, and high mountain regions of Latin America are also uninhabited or thinly settled. Most of the people live near seacoasts or rivers or in the highland areas where there is good, fertile farmland.

Some parts of Latin America are extremely crowded. Barbados, Puerto Rico, and certain other West Indian islands rank among the most densely populated places in the world. Other areas in Latin America that are heavily populated include southeastern Brazil and much of Brazil's coast; east-central Argentina; central Mexico; and the northern regions of Colombia and Venezuela.

Ancestry. Latin America has a varied population in terms of ancestry. The main population groups are (1) Indians, (2) whites, (3) blacks, and (4) people of mixed ancestry.

Most Latin-American countries have a class system based largely on ancestry. The relatively small upper class consists chiefly of whites. People of mixed ancestry make up most of the middle class. The large lower class consists mainly of Indians or blacks. However, social position is not decided only on the basis of ancestry. Being of Indian, black, or mixed descent does not necessarily restrict a person to low social status. In Brazil and the West Indies, for example, many black people have become prominent in the arts, business, politics, or science. In Mexico, having Indian ancestry is a point of pride for people of all walks of life. On the other hand, being white does not guarantee high social position. White people can be found in all classes. However, there are higher percentages of white people among the lower classes in countries that have small Indian or black populations.

Indians lived in Latin America long before the first white settlers arrived in the late 1400's. The Indians descended from people who migrated to North America from Asia thousands of years ago. Such groups as the Aztec, Inca, and Maya developed highly advanced civilizations. The whites soon conquered most of the Indians and forced them to work in mines or on plantations. Millions of Indians died of harsh treatment, in warfare, or of diseases brought by the whites. In some areas of Latin America, the Indian population almost completely disappeared. To survive, many Indians moved to highland areas or remote forest regions. Today, Indians make up a large percentage of the population in Bolivia, Ecuador, Guatemala, and Peru.

Whites. Most white Latin Americans are of European descent. At first, nearly all the region's white settlers came from Spain or Portugal. But since the early 1800's, Latin America has attracted numerous immigrants from other European nations. Many people from France, Germany, Italy, the Netherlands, Poland, and the United Kingdom have settled in Latin America. Today, most of the people of Argentina, Costa Rica, and Uruguay are whites. Brazil and Chile have large white populations.

Blacks were brought from Africa to Latin America as slaves from the 1500's to the 1800's. Europeans brought millions of black people to work on plantations in the West Indies and in coastal areas on the mainland of Central and South America. Today, most of the people of Barbados, Haiti, and Jamaica are blacks. Many other parts of the West Indies—as well as some tropical lowland areas of Central and South America—also have large numbers of blacks.

People of mixed ancestry. Through the centuries, many whites, blacks, and Indians in Latin America have intermarried. As a result, most Latin Americans are of mixed ancestry. The largest groups are *mestizos* (people of mixed Indian and white descent) and *mulattoes* (people of mixed black and white descent). Mestizos make up a majority of the population in El Salvador, Honduras, Nicaragua, Colombia, Mexico, Paraguay, and Venezuela. Mulattoes are numerous in Brazil, Panama, and the West Indies.

Languages. Most Latin Americans speak the language of the European country that colonized their nation. Nearly two-thirds of the people speak Spanish. It is the official language of Cuba, the Dominican Republic, Mexico, and most countries in Central and South America. About a third of all Latin Americans speak Portuguese, the official language of Brazil. French is the official language of Haiti, and Dutch is the official language of Suriname. English is the official language of Belize, Guyana, and other West Indian nations formerly ruled by the United Kingdom (UK). Many Latin Americans speak a dialect of their country's official language or a mixture of languages.

Many Indians in Latin America speak their traditional languages. In Paraguay, an Indian tongue called Guaraní is an official language along with Spanish. Peru's chief Indian tongue, Quechua, is also an official language along with Spanish. Bolivia has three official languages—Spanish, Quechua, and another Indian language called Aymara.

Way of life

City life. About 70 per cent of the people of Latin America live in urban areas. Four Latin-American cities and their suburbs rank among the largest urban centres in the world. They are Mexico City; São Paulo, Brazil; Rio de Janeiro, Brazil; and Buenos Aires, Argentina.

In many ways, large cities in Latin America resemble those in western Europe and North America. Huge skyscrapers rise in busy commercial and financial districts. Tall apartment buildings line broad boulevards. Elegant

Political units in Latin America

Independent countries

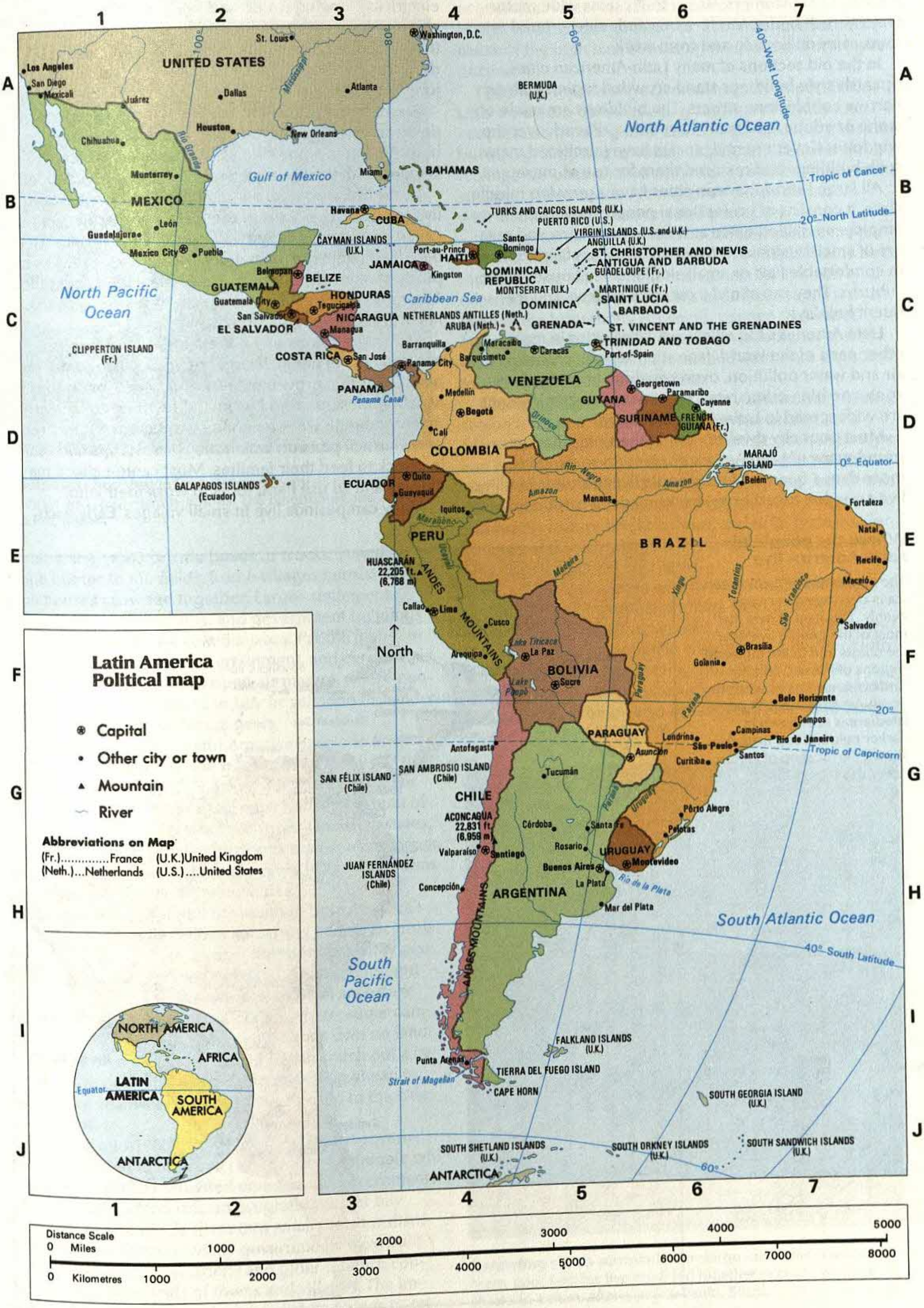
Map key	Name	Capital	Official language
C5	**Antigua and Barbuda**	St. John's	English
H4	**Argentina**	Buenos Aires	Spanish
B4	**Bahamas**	Nassau	English
C5	**Barbados**	Bridgetown	English
C3	**Belize**	Belmopan	English
F5	**Bolivia**	La Paz; Sucre	Spanish; Quechua; Aymara
E6	**Brazil**	Brasília	Portuguese
G4	**Chile**	Santiago	Spanish
D4	**Colombia**	Bogotá	Spanish
C3	**Costa Rica**	San José	Spanish
B3	**Cuba**	Havana	Spanish
C5	**Dominica**	Roseau	English
C4	**Dominican Republic**	Santo Domingo	Spanish
D3	**Ecuador**	Quito	Spanish
C3	**El Salvador**	San Salvador	Spanish
C5	**Grenada**	St. George's	English
C2	**Guatemala**	Guatemala City	Spanish
D5	**Guyana**	Georgetown	English
C4	**Haiti**	Port-au-Prince	French
C3	**Honduras**	Tegucigalpa	Spanish
C4	**Jamaica**	Kingston	English
B2	**Mexico**	Mexico City	Spanish
C3	**Nicaragua**	Managua	Spanish
D3	**Panama**	Panama City	Spanish
G5	**Paraguay**	Asunción	Spanish
E4	**Peru**	Lima	Spanish; Quechua
C5	**St. Christopher and Nevis**	Basseterre	English
C5	**St. Lucia**	Castries	English
C5	**St. Vincent and the Grenadines**	Kingstown	English
D6	**Suriname**	Paramaribo	Dutch
C5	**Trinidad and Tobago**	Port-of-Spain	English
H6	**Uruguay**	Montevideo	Spanish
D5	**Venezuela**	Caracas	Spanish

Other political units

Map key	Name	Capital	Status
B5	**Anguilla**	The Valley*	UK dependency; some self-government
C4	**Aruba**	Oranjestad	Self-governing part of the Netherlands
B3	**Cayman Islands**	Georgetown	UK dependency
I5	**Falkland Islands**	Stanley	UK dependency
D6	**French Guiana**	Cayenne	Overseas department of France
C5	**Guadeloupe**	Basse-Terre	Overseas department of France
C5	**Martinique**	Fort-de-France	Overseas department of France
C5	**Montserrat**	Plymouth	UK dependency
C4	**Netherlands Antilles**	Willemstad	Self-governing part of the Netherlands
C5	**Puerto Rico**	San Juan	United States commonwealth
B4	**Turks and Caicos Islands**	Grand Turk	UK dependency
C5	**Virgin Islands, British**	Road Town	UK dependency; some self-government
C5	**Virgin Islands, United States**	Charlotte Amalie	U.S. organized unincorporated territory

Each independent country and major dependency has a separate article in *World Book.*

*Unofficial


Latin America Political map
⊛ Capital
• Other city or town
▲ Mountain
River
Abbreviations on Map
(Fr.)..............France
(U.K.)United Kingdom
(Neth.)...Netherlands
(U.S.)....United States
UNITED STATES
Los Angeles
San Diego
Mexicali
Juárez
St. Louis
Dallas
Atlanta
Washington, D.C.
Houston
New Orleans
Mississippi
Rio Grande
Chihuahua
Monterrey
MEXICO
León
Guadalajara
Mexico City
Puebla
Gulf of Mexico
Miami
BAHAMAS
BERMUDA (U.K.)
North Atlantic Ocean
Tropic of Cancer
20° North Latitude
40° West Longitude
100°
80°
60°
Havana
CUBA
TURKS AND CAICOS ISLANDS (U.K.)
PUERTO RICO (U.S.)
VIRGIN ISLANDS (U.S. and U.K.)
ANGUILLA (U.K.)
ST. CHRISTOPHER AND NEVIS
ANTIGUA AND BARBUDA
GUADELOUPE (Fr.)
MONTSERRAT (U.K.)
MARTINIQUE (Fr.)
SAINT LUCIA
BARBADOS
DOMINICA
GRENADA
ST. VINCENT AND THE GRENADINES
TRINIDAD AND TOBAGO
Port-of-Spain
CAYMAN ISLANDS (U.K.)
Port-au-Prince
HAITI
Santo Domingo
DOMINICAN REPUBLIC
JAMAICA
Kingston
Belmopan
BELIZE
GUATEMALA
Guatemala City
HONDURAS
Tegucigalpa
San Salvador
EL SALVADOR
NICARAGUA
Managua
Caribbean Sea
NETHERLANDS ANTILLES (Neth.)
ARUBA (Neth.)
North Pacific Ocean
CLIPPERTON ISLAND (Fr.)
COSTA RICA
San José
PANAMA
Panama City
Panama Canal
Barranquilla
Maracaibo
Barquisimeto
Caracas
VENEZUELA
Georgetown
GUYANA
Paramaribo
SURINAME
Cayenne
FRENCH GUIANA (Fr.)
Medellín
Bogotá
Cali
COLOMBIA
Orinoco
Rio Negro
MARAJÓ ISLAND
Belém
0° Equator
GALAPAGOS ISLANDS (Ecuador)
ECUADOR
Quito
Guayaquil
Amazon
Manaus
Fortaleza
Iquitos
Marañon
PERU
Ucayali
BRAZIL
Natal
Recife
Maceió
Madeira
Xingu
Tocantins
São Francisco
HUASCARÁN 22,205 ft. (6,768 m)
ANDES MOUNTAINS
Callao
Lima
Cusco
Lake Titicaca
La Paz
BOLIVIA
Sucre
Salvador
Brasília
Goiânia
North
Arequipa
Lake Poopó
Paraguay
Paraná
Belo Horizonte
Campos
20°
PARAGUAY
Londrina
Campinas
Rio de Janeiro
São Paulo
Santos
Tropic of Capricorn
Antofagasta
Asunción
Curitiba
SAN FÉLIX ISLAND (Chile)
SAN AMBROSIO ISLAND (Chile)
Tucumán
CHILE
Uruguay
Pôrto Alegre
ACONCAGUA 22,831 ft. (6,959 m)
Córdoba
Santa Fe
Pelotas
Rosario
URUGUAY
Valparaíso
Santiago
Montevideo
JUAN FERNÁNDEZ ISLANDS (Chile)
Buenos Aires
La Plata
Rio de la Plata
Concepción
ARGENTINA
Mar del Plata
South Atlantic Ocean
40° South Latitude
ANDES MOUNTAINS
South Pacific Ocean
FALKLAND ISLANDS (U.K.)
Punta Arenas
Strait of Magellan
TIERRA DEL FUEGO ISLAND
CAPE HORN
SOUTH GEORGIA ISLAND (U.K.)
SOUTH SHETLAND ISLANDS (U.K.)
SOUTH ORKNEY ISLANDS (U.K.)
SOUTH SANDWICH ISLANDS (U.K.)
60°
ANTARCTICA
NORTH AMERICA
AFRICA
Equator
LATIN AMERICA
SOUTH AMERICA
ANTARCTICA
1
2
3
4
5
6
7
A
B
C
D
E
F
G
H
I
J
Distance Scale
0 Miles 1000 2000 3000 4000 5000
0 Kilometres 1000 2000 3000 4000 5000 6000 7000 8000

shops, restaurants, bars, and nightclubs attract large numbers of customers. Heavy traffic jams wide motorways at rush hours. Modern bus and underground systems carry millions to and from work.

In the old sections of many Latin-American cities, Spanish-style buildings stand crowded together along narrow cobblestone streets. The buildings are made of stone or adobe, and many have iron grillwork over the windows. Government agencies have purchased many such buildings and restored them for use as museums.

All large Latin-American cities have a growing middle class. It consists of professional people, government employees, skilled office and factory workers, and owners of small businesses. Most middle-class families live in comfortable flats or small single-family houses in the suburbs. They can afford a car, nice clothes, and frequent holidays.

Latin America's big cities, like large cities in many other parts of the world, face such serious problems as air and water pollution, overcrowding, housing shortages, and high crime rates. Poverty and unemployment are widespread in Latin-American cities.

Most poor city dwellers live in the slums that surround many of Latin America's cities. In some cities, more than a quarter of the people live in slums. Families live crowded together in shacks made of cardboard, wood, and tin on land they do not own. Most slums lack electricity, running water, and sewers. Millions of slum children have been abandoned by their parents because they cannot feed or clothe them. These homeless children wander the streets and must beg, steal, or take odd jobs to survive.

A number of Latin-American governments have torn down slums and replaced them with low-cost public housing. But in many cities, the construction cannot keep up with the rapidly increasing urban population.

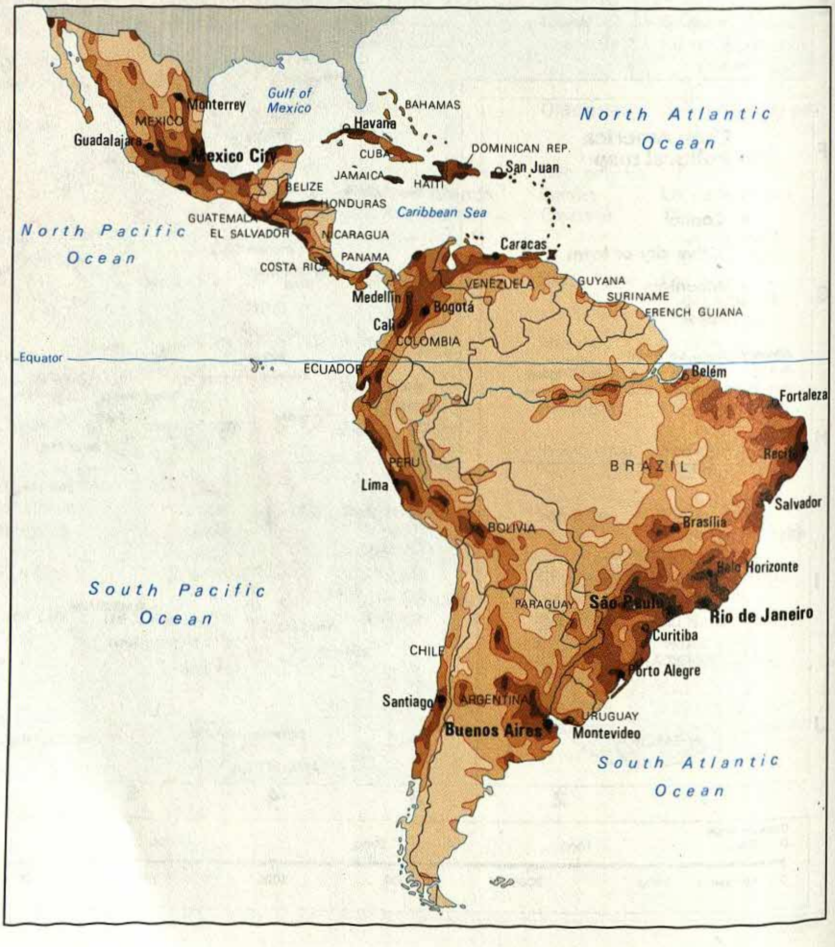
Rural life. About 30 per cent of all Latin Americans live in rural areas. Most of them are poor farmers, often called *campesinos* in Spanish. Most campesinos earn a bare living on huge plantations owned by wealthy people or private corporations. These plantations are called *haciendas* in Spanish-speaking countries and *fazendas* in Portuguese-speaking Brazil.

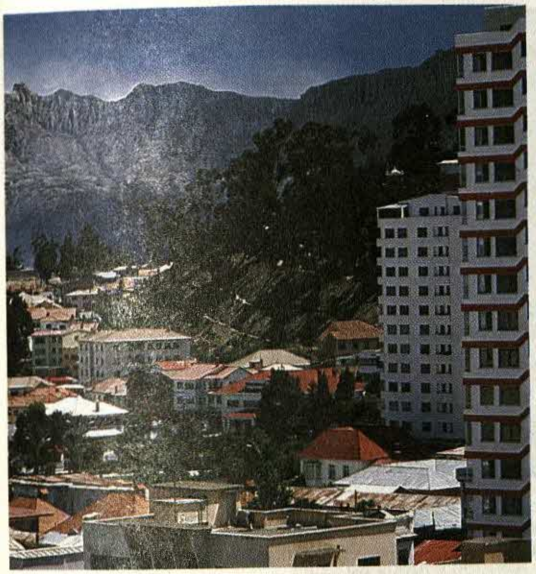
Most campesinos in the West Indies and tropical coastal areas of the mainland are blacks. They work on plantations that grow bananas, sugar cane, or cotton. Most campesinos who live inland on the mainland are mestizos. Some work on coffee plantations. Others rent or own small plots on which they grow crops and rear livestock to feed their families. Most cannot afford machinery and so use hand tools to work their land.

Many campesinos live in small villages. Early each

Where the people of Latin America live

The population of Latin America is distributed very unevenly. This map shows that most of the people live near the coasts and in the highland regions of Mexico and the Andes Mountains of western South America. Heavily populated areas are shown in darker colours. The map also shows the location of Latin America's largest cities.





Middle-class housing in Latin America consists of apartment buildings and single-family homes. The neighbourhood above is in La Paz, Bolivia.

morning, they walk or ride buses or trucks from their village homes to the fields. Some villages consist of only a few houses crowded together. Larger settlements have a church, a few shops, and government buildings around a public square called a *plaza*. People gather in the plaza for socializing, entertainment, and ceremonies. Many villages also have an open-air market, where people gather on the weekend to buy or sell food or handmade goods and to exchange news.

Most rural houses in Latin America have one or two rooms. In tropical areas, the houses may have walls of wood or mud and sticks, earthen floors, and thatch or tin roofs. In mountain villages, most houses are built of stone or adobe and have red tile roofs. On their estates, wealthy landowners live in luxurious mansions. However, many landowners hire managers to run their farms and spend most of their time in cities.

The uneven distribution of wealth in Latin America's rural areas has led to serious social and economic problems. In most countries, a small number of wealthy people own nearly all the best farmland. Most of this land was originally held by the owners' colonial ancestors and is used to grow bananas, coffee, maize, sugar cane, and other export crops. Most campesinos own no land. Those who own or can rent small plots scratch out a living from the poor soil. Despairing of getting ahead in the country, many campesinos have flocked to the cities to seek jobs.

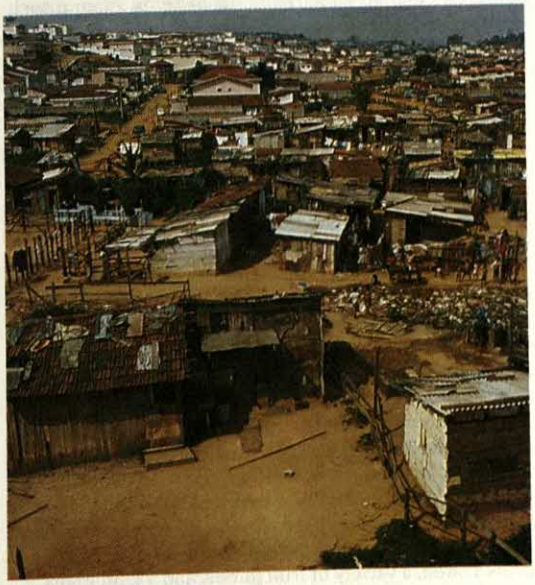
Since the mid-1900's, many Latin-American governments have tried to improve rural life so that people will not move to already crowded cities. Some governments have established land reform programmes that buy large estates and divide them into small plots for distribution to poor farmers. Many governments have built roads and extended electricity and other modern conveniences to thousands of towns and villages. The improved roads have opened up uninhabited areas to settlers. Since the 1960's, many families have moved from economically depressed rural areas to new settlements. However, a number of these settlements have failed because of the high cost of making the poor soil more productive.

Family life has always been extremely important in Latin-American culture. Strong feelings of loyalty and cooperation bind together not only parents and children but also grandparents, aunts, uncles, and cousins. Such feelings are often shared with friends and business associates. This *extended family* provides its members with financial help, security, and social life.

The typical Latin-American household consists of parents, children, and grandparents. Some households also include other family members. Generally, the man who contributes most to the family's economic support is the head of the household. However, women make most household decisions. Children learn obedience toward their parents, and both children and adults are expected to show respect for their elders.

Clothing. Clothing styles in Latin America vary from region to region, depending on climate and custom. Many city people wear clothing like that worn in Europe and North America. But many villagers prefer traditional clothing styles. On holidays and other special occasions, many Latin Americans wear traditional costumes, which commonly feature bright colours and bold patterns. For pictures of these traditional costumes, see the article **Clothing** (Traditional costumes).

Rural Latin Americans who live in tropical climates prefer lightweight cotton clothing. Men usually wear loose-fitting shirts. Most women dress in long skirts and blouses. People in mountain villages need heavier clothing for protection against the cold. Both men and women wear *ponchos* (blankets with a slit in the middle for the head). Women also dress in full skirts and long-



Sprawling slums surround many large Latin-American cities. Many poor families live crowded together in crude wooden shacks in a slum, *above,* in São Paulo, Brazil.

Preparing tortillas (flat bread made from maize or wheat flour) is a daily task for these Mexican women. Many people in Mexico and Central America eat tortillas at every meal. Most Latin Americans cannot afford meat often, and grain is their chief food.

Outdoor markets like this one in Riobamba, Ecuador, can be found throughout Latin America.

sleeved blouses. They commonly drape brightly coloured shawls around their shoulders. In the highlands, men wear coarse handwoven shirts and baggy trousers. Farmers wear straw or felt hats for protection against the sun while working in the fields. Rural people generally go barefoot or wear homemade sandals, many of which have soles made from old car tyres.

Clothing styles in some parts of Latin America are highly distinctive. For example, Indian women who live in the highlands of Bolivia wear black bowler hats. The *gauchos* (cowboys) of Argentina and Uruguay dress in ponchos, baggy trousers tucked into low boots, and wide-brimmed hats. Many Indian groups wear brightly coloured clothing with traditional patterns. Among such groups, each village has its own special colours and designs, which have been used for hundreds of years. Numerous Indian women wear braided belts around their waists. They often use the belts as headbands to hold in place bundles that they carry on their heads.

Food and drink. Grain is the chief food of most Latin Americans. Many people in Mexico and Central America serve *tortillas* (flat bread made from maize or wheat flour) at most meals. Beans and rice form a major part of the diet of most West Indians. People who live in the mountainous areas of South America commonly eat potatoes. People in tropical areas eat a starchy root called *cassava*. In Argentina and Uruguay, people eat many foods made from wheat.

Most Latin Americans eat little meat because they cannot afford it. But people eat a great deal of beef in the cattle-rearing countries of Argentina and Uruguay. People who live along rivers or near the oceans commonly eat fish and shellfish. Many Latin-American dishes are highly seasoned with onions and hot peppers. In tropical areas, the people enjoy such fruit as bananas, mangoes, oranges, and pineapples. Latin Americans drink coffee, a variety of fruit juices, and a kind of tea called *maté* (see **Maté**). Favourite alcoholic beverages include beer, rum, wine, and *aguardiente*, a brandylike drink made from sugar cane.

Recreation. Latin Americans enjoy a wide variety of outdoor activities. Soccer is the region's most popular sport. Many boys and girls begin playing soccer as soon as they can walk. Hundreds of thousands of spectators jam huge stadiums throughout Latin America to watch professional soccer games. Soccer stars have become national heroes. The Brazilian star Pelé won fame as the world's greatest soccer player in the 1960's.

Baseball is especially popular in parts of the West Indies and in mainland countries that border the Caribbean Sea. A number of Latin Americans have become stars in professional baseball teams in the United States and Canada. Cricket is popular in the Bahamas, Jamaica, and Trinidad and Tobago. Bullfights draw large crowds in Colombia, Mexico, Peru, and Venezuela. Other popular sports include car racing, basketball, horse racing, and volleyball.

In coastal areas, large crowds regularly flock to beaches at weekends. Favourite activities include boating, fishing, swimming, surfing, and water-skiing. Many families take overnight camping trips to national forests. During the winter months, well-to-do people enjoy skiing at beautiful mountain resorts.

Large numbers of Latin Americans take part in colourful *fiestas* (festivals), which are held on national or religious holidays. Many fiestas feature colourful parades with richly decorated floats, costumed street dancers, lively musical performances, games, and fireworks.

Religion. Most Latin Americans are Christians. The great majority are Roman Catholics, but a growing number belong to Protestant churches. The laws of all Latin-American countries guarantee freedom of worship, though some countries officially support the Roman Catholic Church. Other religious groups include Buddhists, Hindus, and Jews. Some Indian and black peoples worship the gods of their own cultures.

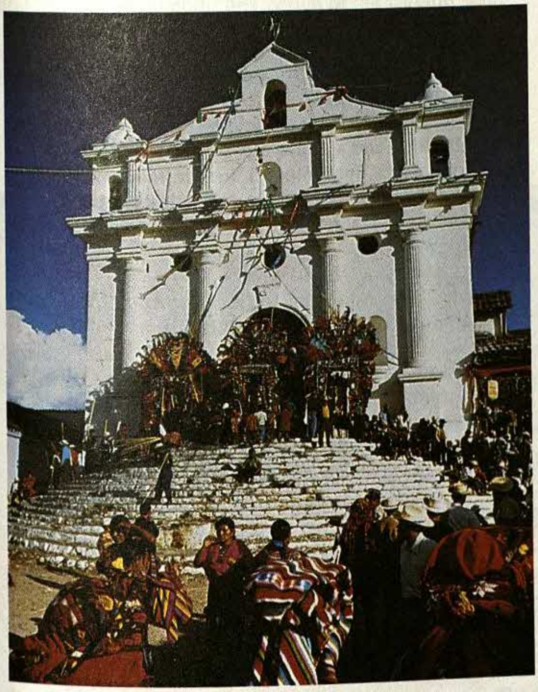
***Roman Catholicism*.** The early Spanish and Portuguese explorers brought the Roman Catholic religion to much of Latin America and converted many Indians to Catholicism. Today, about 80 per cent of the people belong to the Roman Catholic Church. Many people of Indian or black African ancestry combine Catholic religious practices with spiritual beliefs of their own traditions.

In some Latin-American countries, the Roman Catholic Church greatly influences the daily lives of the people. Church officials represent a wide range of political opinion and participate in all levels of government. In addition to performing their religious duties, many neighbourhood and village priests work for social reforms on behalf of the poor in their districts.

During the early 1900's, the Catholic Church became closely linked to military leaders and wealthy landowners who controlled many Latin-American governments. Since the late 1960's, however, the church has become increasingly active in the fight for civil and human rights and social justice. Many Catholic officials have sharply criticized Latin-American governments for failing to provide adequate services for the poor. This criticism has led to serious clashes between religious and political leaders in a number of countries. See **Roman Catholic Church** (In Latin America).

Protestantism. Protestants make up about 5 per cent of Latin America's population. They include Baptists, Episcopalians, Lutherans, and Methodists. Many Protestants live on West Indian islands formerly ruled by the United Kingdom and in the Netherlands Antilles.

Since the late 1960's, millions of Latin Americans have joined a variety of churches based on *Pentecostalism*. Pentecostalism is an emotional form of worship that emphasizes prayer (see **Pentecostal churches**). Most new members of Pentecostal churches are former Catholics who had given up that religion. Many of them disagreed with the Catholic Church's active involvement in social reform movements. The Church of Jesus Christ of Latter-day Saints has also won many converts. It and the Pentecostal churches are the fastest-growing religious groups in Latin America.



Religious festivals, called *fiestas,* are an important part of Latin-American life. These Guatemalans, wearing colourful traditional costumes, are celebrating the fiesta of Saint Thomas.

Education in Latin America has improved greatly since 1960. Larger percentages of Latin Americans than ever attend primary schools, secondary schools, and colleges. In many countries, the *literacy rate* (percentage of people aged 15 or older who can read and write) has increased enormously. In such nations as Argentina, Chile, Cuba, and Uruguay, the literacy rate is more than 90 per cent. Many nations have set up programmes to teach uneducated adults to read and write. In spite of the progress in education, serious problems remain. In such countries as Guatemala and Haiti, the literacy rate is less than 60 per cent. Throughout Latin America, educational levels are generally lower in rural areas than they are in the cities.

Nearly all Latin-American nations require children to complete elementary school. But many students, particularly in rural areas and urban slums, cannot fulfil this requirement because of a shortage of schools, educational materials, and qualified teachers. Numerous other students must leave school after a few years to look for work and help support their families. All Latin-American governments have built schools and sponsored programmes to extend education to more people. However, the population is growing faster than schools can be built or teachers trained. In addition, the costs of education are constantly increasing.

In many Latin-American countries, students can receive a free state education from kindergarten through college. However, large numbers of students, especially from middle- and upper-class families, go to private schools, which charge for tuition. The private schools also receive government funds. The Catholic Church operates many private schools in Latin America. For many years, private schools provided a better education than did state schools. But increased financial support has enabled many state schools to offer an education at least equal to that of private schools.

Latin America has a number of excellent state and private colleges and universities. Four of the universities date from the 1500's. Santo Domingo University in the Dominican Republic was founded in 1538. It is the oldest institution of higher learning in the Western Hemisphere. The National University of San Marcos in Lima, Peru, and the National Autonomous University of Mexico in Mexico City date from 1551. Saint Thomas University in Bogotá, Colombia, dates from 1580.

Enrolment in Latin America's colleges and universities has increased greatly since the 1960's. In several nations, the number of qualified secondary school teachers who want to attend state universities exceeds the number that these schools can enrol. Many Latin-American countries have a shortage of skilled workers, scientists, teachers, and other professionals. To meet the need for such workers, many nations have built technical schools that prepare young people for careers in agriculture, business, and engineering.

Latin America has some fine public and school libraries. There are also many national libraries and libraries for universities and other educational institutions.

The arts

The artistic traditions of Latin America date back thousands of years to the region's ancient Indian cultures. The ruins of magnificent temples and other structures built by advanced Indian civilizations still stand in such countries as Mexico, Peru, and Guatemala. The Indians also produced beautiful textiles, jewellery, pottery, and other handicraft items. When Spanish and Portuguese colonists began arriving in Latin America during the late 1400's, they brought their European artistic traditions with them. European styles dominated the region's arts for hundreds of years. After the colonists imported black slaves, African traditions influenced such arts as popular music and dancing. During the 1800's and 1900's, various Latin-American arts began to develop a strong national character, rather than reflect European styles.

Architecture. Highly developed Indian civilizations constructed enormous buildings and impressive cities before the first Europeans reached Latin America. The greatest Indian architects were the Aztec and Toltec in Mexico, the Maya in Mexico and Central America, and the Inca in the Andes Mountains of western South America. The outstanding Aztec, Maya, and Toltec structures were huge stone pyramids topped by temples. Inca architects designed cities that clung to mountainsides. The stones for Inca buildings were cut so precisely that they fit together without cement. See **Architecture** (Pre-Columbian architecture).

Magnificent religious art of the Spanish colonial period can still be found in many Latin-American churches. The elaborate altar above is in La Compañía, a cathedral in Quito, Ecuador.

Spectacular folk dances are performed by the Ballet Folklórico of Mexico. The company preserves the traditional dances of the Indians of Mexico and the settlers from Spain.

The first major buildings constructed by Europeans in Latin America had a religious or governmental purpose. Some of the finest structures were huge cathedrals and sprawling monasteries that included a church, chapels, living quarters, and a courtyard surrounded by high, thick stone walls. Beginning in the late 1600's, many cathedrals, palaces, and mansions were built in the *baroque* style of architecture. This style featured elaborately carved columns, ornate sculptures, and lavish use of coloured tile, gold, and silver.

Modern Latin-American architecture combines simple geometric forms with bold decorations and curving shapes inspired by the region's Indian and baroque heritage. Many architects cover all or part of their buildings with stunning paintings or *mosaics* (designs or pictures made of pieces of stone or other material). Such buildings can be found in the National Autonomous University of Mexico in Mexico City and in the Central University of Venezuela in Caracas. The great Brazilian architect Oscar Niemeyer created strikingly modern designs for buildings in Brasília, the capital of Brazil.

Literature. Latin-American literature includes works by writers from the Spanish-speaking countries and Puerto Rico and from Portuguese-speaking Brazil. For a discussion of the region's rich literary tradition, see **Latin-American literature.**

Painting. Precolonial Latin-American painting includes brilliantly coloured murals by Indian artists.

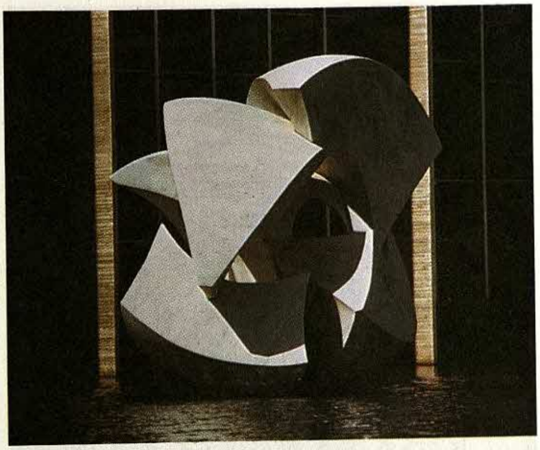
Some of these murals decorate temples and feature lifelike figures taking part in battles and ceremonies. Some Indian groups also painted pottery and sculptures.

During colonial times, many Latin-American painters imitated European styles. Most artists painted pictures with religious themes for churches and cathedrals. The leading centres of painting during the colonial period included Mexico City; Quito, Ecuador; and Cusco, Peru.

About 1900, Latin-American artists began to develop painting styles that were distinctly Latin American. Many of them adopted the vivid colours and bold designs that stemmed from the region's Indian heritage. Such Mexican artists as José Clemente Orozco, Diego Rivera, and David Siqueiros became famous for their gigantic murals. The murals portray scenes from Mexican history, especially the struggle for independence and Mexico's 1910 revolution. The Brazilian painter Cândido Portinari used modern abstract styles to create powerful pictures of everyday life in Brazil. In Haiti, an outstanding group of self-taught artists, including Hector Hyppolite and Philomé Obin, has produced imaginative scenes of local life and folklore.

Sculpture. Before the Europeans arrived, Latin-American Indians created many beautiful sculptures, ranging from masks and statuettes to huge, elaborately carved panels and monuments. Indian sculptors carved a large number of their works from stone, but they also used clay, jade, gold, and wood. Many of their sculptures depicted gods and religious symbols and were used to decorate temples and religious centres. See **Sculpture** (American Indian).

Early colonial sculpture consisted mainly of architectural decoration on churches. Much of the carving was in the *plateresque* style, a form of stone design that resembled the delicate work of *plateros* (silversmiths). The Brazilian sculptor Antônio Francisco Lisbôa, also known as Aleijadinho, created some of the finest works of the late 1700's and early 1800's. He carved magnificent religious figures from wood and stone for churches in the Brazilian state of Minas Gerais.



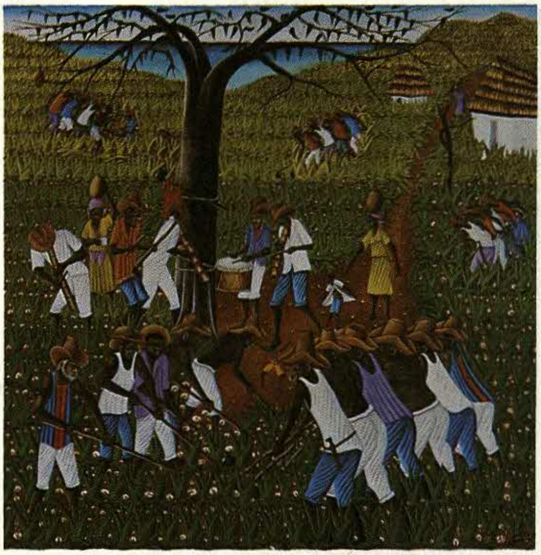
Modern Latin-American sculpture differs greatly from the ornate style of colonial times. This marble work, titled *Meteor,* was made in the 1960's by Bruno Giorgi, a Brazilian sculptor.

Since the mid-1800's, much Latin-American sculpture has reflected a strong national pride and a growing interest in the region's Indian heritage. Many sculptors have produced impressive monuments to heroes of Latin America's revolutions and wars of independence.

Music. Latin Americans enjoy many kinds of music. Street performances of live music are common in the region. Performances of traditional Indian and black music and Western classical music draw large and enthusiastic crowds. Rock music is also popular among young Latin Americans.

Indian music of Latin America dates from precolonial times. It played a major part in most Indian ceremonies and remains important in areas that have a large Indian

Colourful Mexican murals became internationally famous during the 1900's. This mural by David Siqueiros decorates the Administration Building of the National Autonomous University of Mexico in Mexico City.



Coumbite (1971), an oil painting on masonite by Gerard Valcin

Latin-American painting by self-taught artists in Haiti draws upon themes from local life and folklore. The painting above shows workers on a Haitian plantation.

population. European settlers introduced Western musical forms and instruments into Latin America. *Mestizo music* combines Indian tunes with lively Spanish strains. Music in the West Indies and coastal mainland areas reflects African traditions introduced by black plantation slaves. Complicated African rhythms can be heard in the *calypso* music of Trinidad and in the *samba* and *bossa nova* styles of Brazil.

In playing traditional Latin-American music, musicians use various special instruments. These instruments include wooden and steel drums; the *cuatro* (a four-stringed guitar); the *marimba* (an instrument similar to the xylophone); and *maracas* (rattles made from gourds). Much traditional music also features flutes, harps, horns, violins, and tambourines.

Many large cities in Latin America have symphony orchestras, chamber groups, and opera companies. These organizations perform the works of the great European classical composers. European styles strongly influenced the region's classical music until the 1800's. A number of Latin-American composers then began to express their national heritage in their music. During the 1900's, such internationally known composers as Heitor Villa-Lobos of Brazil and Carlos Chávez of Mexico used folk melodies and rhythms as well as traditional instruments in their works.

Dancing has long been important in the lives of Latin Americans. Indians and blacks developed dances to accompany religious worship, to celebrate such events as birth and marriage, and to mourn the dead. European immigrants introduced the folk dances of their native countries into Latin America. Dancing continues to play a major role in the religious ceremonies and community celebrations of many Latin Americans. It is also a highly popular form of recreation. In many countries, national dance companies stage colourful productions of traditional folk dances. One of the most famous companies is the Ballet Folklórico of Mexico, which has performed in many parts of the world.

Most Latin-American countries have their own traditional dances. Many of these dances include steps from Spanish or Portuguese folk dances. For example, the Spanish *zapateado* (heel-beating steps) are part of the *cueca* of Bolivia and Chile; the *joropo* of Venezuela; and the *jarabe tapatío*, or *Mexican hat dance*, of Mexico. In the West Indies, African and Spanish influences were combined in such ballroom dances as the *rumba* and *cha-cha*. The rumba, cha-cha, and some other Latin-American dances, including the Argentine *tango*, Brazilian *samba*, and Cuban *conga*, are popular outside Latin America.

Handicrafts. Many handcrafted items made by Latin Americans combine artistic beauty with practical use. This type of art is called *artes populares* (popular arts) and is part of daily life in much of Latin America. Superb craftwork can be found in tools and household items as well as in ornaments and religious objects. Latin Americans have long been famous for their excellent glassware, metalwork, pottery, and textiles.

Most handicrafts are inexpensive. Many craftworkers produce these items in their homes using local materials. For example, Indians of the Andes Mountains weave wool from such animals as alpacas and llamas into beautifully designed ponchos and sweaters. In the West Indies, people make dishes for baking seafood from sea shells and carve coconut shells into serving dishes. In the tropical lowlands of Central America, people make lightweight chairs from sturdy plant fibres.

Many handcrafted items are decorated with such folk art figures as chickens, dogs, and frogs or with Indian religious symbols. The *eye of god*, an Indian religious symbol, is a popular wall decoration. It consists of coloured threads woven in a special pattern around crossed sticks.

Handicrafts are practised widely in Latin America. The Indians are famous for their metalwork, pottery, and textiles. This Zapotec Indian of Mexico is weaving brightly coloured cloth.

History

This section traces the broad outlines of Latin-American history. For the history of a particular country, see the *World Book* article on that country. See also the articles listed under "Biographies" and "History" in the *Related articles* at the end of this article.

The first inhabitants of Latin America were American Indians. Scientists believe that the ancestors of these Indians came to North America from Asia more than 20,000 years ago. At that time, a land bridge connected Asia and North America where the Bering Strait now separates Siberia and Alaska. The people from Asia probably crossed the land bridge, following the animals they hunted. The descendants of these people became known as Indians. By about 6000 B.C., the Indians had spread throughout much of the Americas to the southern tip of South America.

For thousands of years, the Indians lived in small groups. They travelled continuously in search of animals and wild plants for food. Eventually, some Indians began to farm the land. The Indians were the first people to grow cacao, maize, kidney and Lima beans, peanuts, potatoes, squash, tobacco, and tomatoes. Indians who farmed could remain in one place and produce enough food for many others. They built permanent houses and settled in small villages. As the Indian population increased, some villages grew into towns and cities, and several advanced civilizations developed.

The earliest Indian civilization in the Americas was probably that of the Olmec. The Olmec civilization thrived in what is now eastern Mexico from about 1200 to 400 B.C. The Maya civilization of southern Mexico and northern Central America reached its peak between about A.D. 250 and 900. The Maya produced magnificent architecture, painting, pottery, and sculpture. They developed a calendar and an advanced system of writing. The Maya also had great knowledge of astronomy, which helped them accurately to predict growing seasons for their crops. They also built a vast system of underground irrigation canals.

Maya ruins include the Temple of the Giant Jaguar, *above*, in Guatemala. The Maya civilization reached its height in Mexico and Guatemala between about A.D. 250 and 900.

Important dates in Latin America

c. 6000 B.C. Indians had spread throughout much of the Americas to the southern tip of South America.

A.D. 250-900 The civilization of the Maya Indians, located in southern Mexico and northern Central America, reached its peak.

1400's-early 1500's The Aztec in Mexico and the Inca in western South America controlled large empires.

1492 Christopher Columbus became the first European to reach Latin America.

1494 Spain and Portugal agreed to the Line of Demarcation, which fixed their areas of rule in Latin America.

Early 1500's Spanish troops conquered most of Latin America's Indian civilizations.

Early 1800's Most Latin-American colonies gained independence.

Late 1800's Cooperation between Latin-American countries and the United States, called *Pan-Americanism*, began to grow.

Mid-1900's Violence erupted in many Latin-American countries as rival political groups struggled for power.

1959 Fidel Castro established a Communist state in Cuba.

1980's Several Latin-American countries regained civilian rule after a period of military rule.

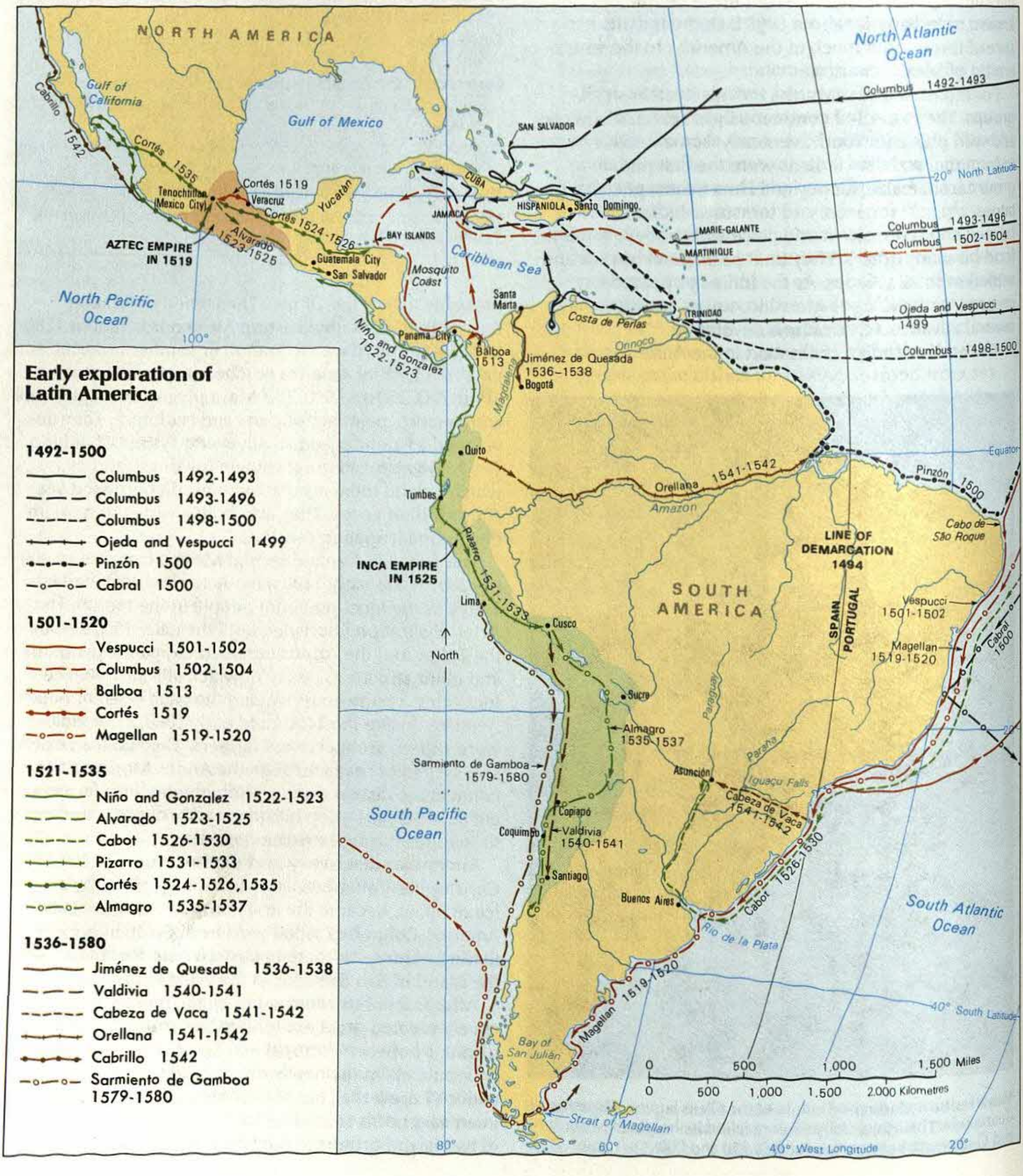
The Toltec controlled central Mexico from about 900 to 1200. By the early 1400's, the Aztec had replaced the Toltec as the most powerful people in the region. The Aztec civilization flourished until the early 1500's. Both the Toltec and the Aztec constructed gigantic pyramids and other structures, many of which still survive. The Inca ruled a huge empire along the west coast of South America during the 1400's and early 1500's. The Inca were superb architects and farmers. They built an extensive system of roads through the Andes Mountains to connect the distant cities of their empire. Inca farmers cut terraces into steep hillsides and brought water to these plots through irrigation canals.

European discovery and exploration. In 1492, Christopher Columbus, an Italian navigator in the service of Spain, became the first European to reach Latin America. Columbus sailed west from Spain in hope of finding a short sea route to eastern Asia. He landed on the island of San Salvador in the West Indies.

After Columbus returned to Spain, news of his discovery created great excitement in Europe. To prevent disputes between Portugal and Spain over which country would claim the newly discovered lands, Pope Alexander VI drew the Line of Demarcation in 1493. This imaginary north-south line lay about 560 kilometres west of two island groups in the North Atlantic

Ocean—the Azores and the Cape Verde Islands. All lands west of the line belonged to Spain, and all lands to the east belonged to Portugal. However, the Portuguese soon became dissatisfied because they thought the line gave Spain too much territory. In 1494, Portugal and Spain signed the Treaty of Tordesillas, which moved the line about 2,084 kilometres west. As a result, Portugal settled the eastern section of what is now Brazil. Portugal took possession of this area in 1500, when a Portuguese navigator named Pedro Álvares Cabral landed on the east coast of Brazil.

Columbus made four voyages to Latin America between 1492 and 1502. During these voyages, he explored many islands in the West Indies and the coasts of what are now Honduras, Costa Rica, Nicaragua, Panama, and Venezuela. Other explorers soon followed Columbus to Latin America. The Europeans quickly realized that the region was not Asia but a new land. Mapmakers named the land *America* in honour of the Italian-born explorer Amerigo Vespucci. Vespucci made several voyages to Latin America in the late 1490's and early 1500's for Spain and Portugal. Vespucci was one of the first ex-



Early exploration of Latin America

plorers to state that the region was a "New World."

In 1513, the Spanish adventurer Vasco Núñez de Balboa crossed Panama and became the first European to see the eastern shore of the Pacific Ocean. His discovery provided additional proof that America was a separate continent between Europe and Asia. In 1520, the Portuguese navigator Ferdinand Magellan became the first European to discover the waterway that connects the Atlantic Ocean and the Pacific Ocean at the southern tip of South America. Magellan sailed down the east coast of South America and through the strait that now bears his name.

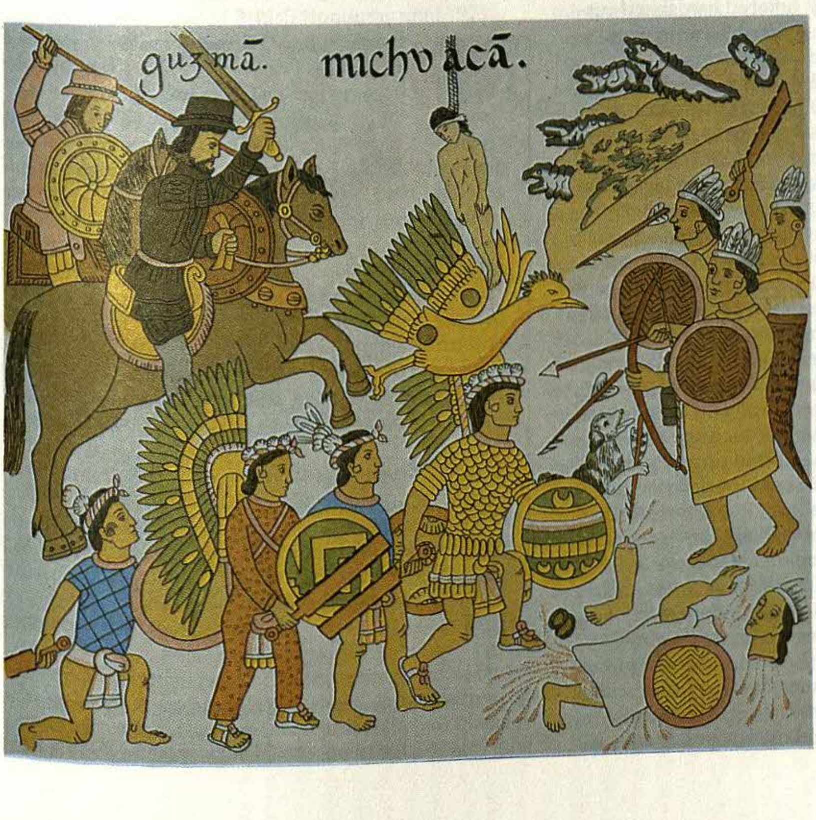
The conquest of the Indians began soon after the Europeans arrived in Latin America. By the mid-1500's, a small group of Spanish adventurers known as *conquistadors* (conquerors) had defeated the great Indian civilizations and given Spain a firm hold on most of Latin America. The conquistadors led relatively small but well-equipped forces. They easily defeated large armies of Indians, who had never seen guns or horses.

The first major conquests of the Indians occurred in Mexico and Central America. The conquistador Hernando Cortés landed in Mexico in 1519. By 1521, he had conquered the great Aztec empire. The following year, another conquistador, known as Pedrarias, conquered the Indians of what are now Costa Rica and Nicaragua. In 1523, Pedro de Alvarado, one of Cortés' officers, conquered what are now El Salvador and Guatemala. These conquistadors, together with Balboa in Panama, secured Central America for Spain.

In 1531, the conquistador Francisco Pizarro sailed south from Panama to what is now Peru. During the next two years, his army marched about 4,800 kilometres through the Andes Mountains and conquered the huge Inca empire. Pizarro founded Lima in 1535. The city became Peru's capital and the centre of Spanish government in South America. One of the few areas the Spanish failed to conquer was southern Chile, where the Araucanian Indians resisted for more than 300 years.

Colonial rule. Even before the military conquest of Latin America was complete, Spanish and Portuguese settlers began pouring into the region. Many of them came in search of adventure and mineral wealth. Others established plantations to grow sugar cane, tobacco, and other crops to export to Europe. Much of Latin America was colonized by the time the first European settlers arrived on the Atlantic coast of North America in the mid-1500's. During the 1600's, the Dutch, English, and French established small colonies in Latin America, chiefly in the West Indies.

Large numbers of Latin-American Indians died of diseases brought by Europeans or were killed in warfare. During the early 1500's, Spain established the *encomienda* system in Latin America. Under this system, colonists were granted large tracts of land plus the Indians who lived on the land. The colonists collected tribute in the form of slave labour from the Indians, making them farm the land or work in the mines. In return, the colonists were supposed to protect the Indians and convert them to Christianity. However, many colonists treated the Indians cruelly. Several outstanding Roman Catholic missionaries, especially Bartolomé de Las Casas,



The Spanish conquest of the Aztec Indians of Mexico was completed in 1521. With their horses and superior weapons, the Spanish easily conquered the Aztec. This drawing by an Aztec artist shows the Spanish and their Indian allies battling Aztec warriors.

pleaded for more humane treatment of the Indians. But millions of Indians died from overwork and harsh treatment. As the Indian population in Latin America declined, Europeans began to import black Africans as slaves (see **Slavery**).

Power in colonial Latin America rested with three groups. One group consisted of government officials appointed by European rulers. In each colony, these officials controlled a highly centralized government. This type of administration, in which a few individuals held power, enabled the Europeans to govern the colonies for one main purpose—to exploit their natural resources to the fullest.

The Roman Catholic clergy was another power group. The clergy controlled education in the colonies and was charged with converting the Indians and blacks to Christianity.

The third power group in colonial Latin America consisted of landowners and mine operators. Many settlements in Latin America sprang up near choice farmland or important mineral resources. As a result, numerous communities lay far from the centres of colonial government. In many such cases, the local landowners or mine operators held economic and political control. Some owners and operators used their power justly, but others were ruthless dictators.

Europe profited tremendously from Latin America's mineral wealth and agricultural products. Ships filled with silver and gold regularly departed from Latin-American ports for Europe. Agricultural exports included coffee, cotton, sugar cane, and tobacco. Over the years, Spain's economy became increasingly dependent on Latin America. The country suffered hardship if vessels from the colonies carrying valuable cargo were sunk in Atlantic storms or raided by pirates.

The beginnings of colonial unrest. Colonial rule of Latin America lasted about 300 years. During that time, discontent among the colonists gradually grew. Many Latin Americans wanted greater control over their economic and political affairs. But the European powers ignored the demands for more self-government until the movement for independence was unstoppable.

The desire for independence among Latin Americans arose for several reasons. The *criollos* (people of Spanish ancestry born in Latin America) resented the fact that officials from Spain held all the top posts in colonial government. These officials looked down on the criollos because they had not been born in Europe.

Dissatisfaction was even greater among Latin Americans of mixed European and Indian ancestry. Many of these *mestizos* had gained wealth and property and wanted to take an active role in colonial government. However, mestizos had little social or political standing among the Europeans who controlled Latin America.

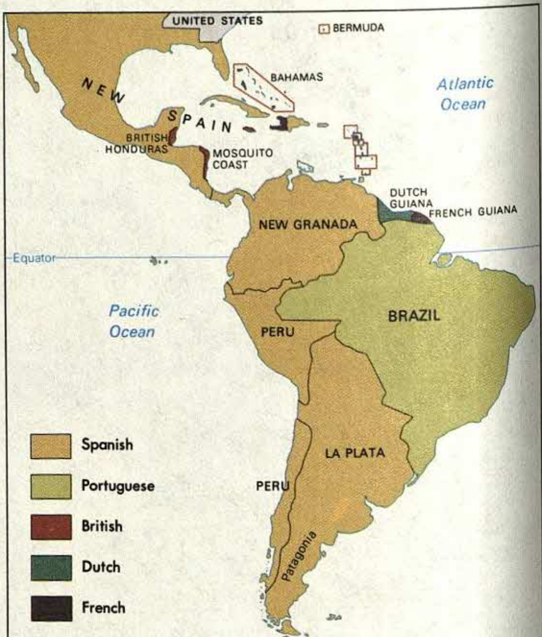
The continual flow of the region's resources to Europe also angered many Latin Americans. Spain and Portugal permitted the colonies to trade only with their mother countries. The colonies could not even trade among themselves. In addition, Spain and Portugal hampered Latin America's economic growth by discouraging the development of manufacturing. The colonial rulers wanted Latin Americans to buy European-made products rather than manufacture products for themselves.

The political and economic injustices suffered by the colonists led to a growing desire for independence in Latin America. Although Spain and Portugal introduced a number of reforms in the colonies before 1800, many Latin Americans still wanted freedom.

The wars of independence in Latin America were finally triggered by events in North America and Europe. The success of the American Revolution (1775-1783) and the ideals of freedom and equality promised by the French Revolution (1789-1799) inspired the unhappy colonists. At the same time, Spain and Portugal were losing their importance as world powers. In 1807, the forces of Napoleon Bonaparte of France invaded and conquered Portugal. The next year, Napoleon drove Ferdinand VII from the Spanish throne and replaced him with his own brother, Joseph Bonaparte. Spain's control over its colonies was thereby weakened, and many Latin Americans took the opportunity to fight for independence.

Mexico began its revolt against Spain in 1810. The struggle was first led by two Roman Catholic priests, Miguel Hidalgo y Costilla and José María Morelos y Pavón. The initial revolt failed, however, and Spanish troops executed both Hidalgo and Morelos. Mexico did not win its independence until 1821.

Central America also gained its freedom from Spain in 1821. Central America had little economic importance, and so Spain largely ignored the area. As a result, Central Americans won their independence without bloodshed. In 1822, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua became part of Mexico. In



In 1790, after about 300 years of colonial rule, five European countries controlled all of Latin America. From then on, revolutions in Latin America weakened European power in the region.

Battle of Junín (1900), an oil painting on canvas by Martín Tovar y Tovar (Angelo Hurtado)

Simón Bolívar, a Venezuelan general, helped several Latin-American colonies win their independence from Spain. This painting shows Bolívar leading his troops in a battle for Peru's freedom.

1823, however, they broke away from Mexico and formed a political union called the United Provinces of Central America. Bitter regional rivalries caused this union to begin to collapse in 1838, and each of the states had become an independent republic by 1841. The territory of Panama was a Colombian province from 1821 until 1903, when it rebelled against Colombia with help from the United States and became an independent country. Belize, called British Honduras until 1973, was a British colony from 1862 to 1981, when it gained independence.

Spanish South America. The two greatest heroes in the fight for independence in Spanish South America were the Venezuelan general Simón Bolívar and the Argentine general José de San Martín. Bolívar helped win freedom for Bolivia, Colombia, Ecuador, Peru, and Venezuela. San Martín fought for the independence of Argentina, Chile, and Peru.

The Venezuelan revolutionist Francisco de Miranda led an unsuccessful revolt against the Spanish in 1806. Bolívar, who had been a follower of Miranda's, launched a new campaign in 1813. His armies fought against the Spanish forces for about 10 years before winning a final, great victory at Ayacucho, Peru, in 1824. The victory assured independence for the Spanish colonies in northern South America.

In the south, landowners in Chile declared their country's freedom in 1810. However, Spanish forces overcame them. Lasting independence was won for Chile in 1818 by armies led by San Martín and the Chilean hero Bernardo O'Higgins. Earlier, in 1816, San Martín had freed Argentina from Spanish rule. His armies later fought for Peru's independence.

Brazil won its freedom from Portugal without firing a shot. When Napoleon invaded Portugal in 1807, the Portuguese ruler, Prince John, fled to Brazil. John returned to Portugal 14 years later, after Napoleon's defeat. He left his son Pedro to govern Brazil. But the Brazilians no longer wanted to be ruled by Europeans. They demanded freedom from Portugal. In 1822, Pedro declared Brazil an independent empire and took the throne as Emperor Pedro I.

The West Indies. In 1791, Toussaint L'Ouverture led black African slaves in Haiti in a revolt against their French rulers. Haiti won its freedom in 1804 and became the first independent nation in Latin America. The Dominican Republic declared its independence in 1844. A revolt broke out against Spanish rule in Cuba in 1895. The United States sided with the Cuban rebels, which led to the Spanish-American War (1898) between Spain and the United States. The United States won the war, and Cuba became a republic in 1902. Under the terms of the peace treaty, Spain also gave up its colony of Puerto Rico to the United States. Most small West Indian islands remained under British, Dutch, or French control until the mid-1900's. Since then, most of these islands have become independent. Many of the others have gained more control over their affairs.

The problems of independence. During colonial times, Latin Americans were governed by the laws of distant monarchs and had almost no voice in their own affairs. When they rebelled and established their own countries, they thus had little experience in government. For that reason, some leaders thought it unwise to establish republics in Latin America. But eager patriots, inspired by the French Revolution and the American Revolution, demanded republican government.

After achieving independence, Latin Americans soon found that it was easier to set up a republican government than to make it work. The inexperience of the new leaders led to violent struggles throughout Latin America. Ambitious dictators seized power in a number of countries. Armies that had fought for independence often helped to keep dictators in power. In other countries, wealthy landowners controlled the government.

Immediately upon gaining independence, many

Border wars broke out between some Latin-American nations after independence. In the War of the Triple Alliance (1865-1870), Argentina, Brazil, and Uruguay defeated Paraguay. Many fierce battles were fought on the Paraguay River *above.*

Latin-American republics abolished slavery. By the late 1800's, all the slaves in the region had been freed. However, independence brought little improvement in the lives of most Latin Americans. Wealthy criollos and mestizos took over the established economic, political, and social institutions. Poor mestizos, Indians, and blacks had little, if any, power. For many of these people, life became even harder than it had been under colonial rule.

Border disputes. Since independence, relations between a number of Latin-American countries have been severely damaged by disagreements over national boundaries. War broke out in 1825 between Argentina and Brazil over disputed territory bordering both countries. A treaty signed three years later established the area as the independent nation of Uruguay. In the War of the Triple Alliance (1865-1870), Argentina, Brazil, and Uruguay defeated Paraguay. The war firmly established the common borders of those countries. About half of Paraguay's population was killed in the conflict. In the War of the Pacific (1879-1883), Chile fought Bolivia and Peru over a nitrate-rich area along the Pacific Ocean. Chile won the war and took possession of the territory, leaving Bolivia without a seacoast. Bolivia has remained landlocked ever since.

From 1932 to 1935, Bolivia and Paraguay fought for control of the Gran Chaco, a lowland region bordering both countries. Most of the area was eventually awarded to Paraguay. Fighting broke out several times during the early 1900's between Peru and Ecuador over a wild, uncharted area of the Amazon River Basin between Ecuador and Brazil. Peru annexed the area in the 1940's, but Ecuador still claims it. In other continuing disputes, Guatemala claims land controlled by Belize, and Venezuela claims about two-thirds of Guyana.

Trade relations and economic developments. Since colonial times, the economies of most Latin-American countries have depended heavily on the export of a few agricultural and mineral products. The exports of some nations consist chiefly of one product—for example, bananas in Honduras; coffee in Colombia; copper in Chile; petroleum in Ecuador, Mexico, and Venezuela; sugar in Cuba and the Dominican Republic; and tin in Bolivia. A drop in the market price for these exports causes severe economic hardships. Since the mid-1900's, many countries have spent large sums of money to develop other industries and so lessen their dependence on agricultural and mineral exports. Many of these countries have received loans from regional and international economic organizations for this purpose. They have also been given economic aid from other nations.

In the past, most Latin-American nations imported many manufactured goods from Europe and the United States. Latin-American countries traded relatively little with one another because they produced similar products. With the growth of manufacturing, however, several economic unions have been formed to encourage regional trade. They include the Latin American Integration Association, the Central American Common Market, the Caribbean Community and Common Market, and the Andean Pact. These organizations work to lower trade barriers among the member countries and to promote economic growth in the region.

Before the 1960's, most major industries in Latin America were owned by United States and European companies. Many Latin Americans believed that these foreign businesses were only interested in making huge profits and cared little for the welfare of the region's people. Since the late 1960's, some countries have passed laws prohibiting foreign ownership of certain key industries. The governments of such nations as Bolivia, Guyana, Peru, and Venezuela took control of industries previously owned by U.S. and European companies. However, most countries also encourage foreign investment in industries that require modernization.

In 1975, most of the region's independent nations joined the Latin American Economic System. The major goals of this organization include the promotion of regional economic interests and the establishment of locally owned companies to offset the influence of European, Japanese, and U.S. businesses.

The movement to establish unity among the nations of North and South America, called *Pan-Americanism,* dates from the early 1800's. In 1826, the great Venezuelan general Simón Bolívar called the first in a series of conferences of the newly independent Latin-American countries. Bolívar believed that the republics needed to work together to solve common problems. But for more than 60 years, national jealousies kept the republics from achieving regional cooperation.

In 1890, the United States and 18 Latin-American nations formed the International Union of American Republics. The central office of this organization, called the Commercial Bureau of the American Republics, was renamed the Pan American Union in 1910. The purpose of the Pan American Union was to establish closer economic, cultural, and political cooperation among member nations. The Organization of American States (OAS) was established in 1948, and the Pan American Union became its permanent governing body. The membership of the OAS consists of the United States together with all the independent countries of Latin America. The OAS seeks to provide for collective self-defence, cooperation within the region, and the peaceful settlement of disputes.

In 1947, the United States and nearly all the Latin-American republics signed the Inter-American Treaty of Reciprocal Assistance. The treaty was drawn up near Rio de Janeiro, Brazil, and is commonly called the Rio Treaty. It states that an armed attack against any country that signed the treaty would be considered an attack against all the other countries.

Latin America and the United States have often had a difficult relationship. The United States supported the Latin-American colonies in their wars of independence. In 1823, U.S. President James Monroe issued the Monroe Doctrine, which warned European powers not to meddle in the affairs of the Western Hemisphere. But the doctrine caused much resentment among Latin Americans. Many of them felt that the United States was assuming its superiority over Latin America by making itself the region's protector.

Numerous Latin Americans distrust the United States because of its great wealth and power. At times, they have suspected it of trying to control the entire hemisphere. Such suspicions arose when the United States fought the Mexican War (1846-1848) after annexing Texas in 1845. Latin Americans were also concerned when the United States won control of Puerto Rico in 1898 as a result of the Spanish-American War.

The presence of U.S. military forces in Latin America increased during the early 1900's. In 1903, U.S. troops helped Panama to win independence from Colombia. In return, Panama gave the United States permanent control of the zone where the Panama Canal was later built. Latin Americans were especially upset when the United States stationed marines in Nicaragua from 1912 to 1933, in Haiti from 1915 to 1934, and in the Dominican Republic from 1916 to 1924. The marines were sent to these countries to protect U.S. interests during times of political unrest. Several Latin-American countries sided with the United States against Germany during World War I (1914-1918), but most remained neutral.

Latin-American distrust of the United States decreased somewhat after a Pan-American conference in 1933. All the nations pledged themselves to the Good Neighbour Policy outlined by U.S. President Franklin D. Roosevelt. The policy provided that no nation would interfere in the affairs of any other nation. During World War II (1939-1945), all the Latin-American nations supported the Allies, though only Brazil and Mexico provided troops.

Since the mid-1900's, the United States has sent billions of dollars and many technical experts to help Latin-American countries solve their social and economic problems. Such aid programmes as the Alliance for Progress and the Peace Corps have helped improve Latin-American agriculture, industry, educational systems, and health services.

Relations between Latin America and the United States showed signs of strain during the 1970's and early 1980's. The United States cut back its aid to some Latin-American governments that had violated the civil rights of their citizens. For their part, many Latin Americans saw hidden motives in U.S. actions and aid programmes. They opposed U.S. influence in their affairs and demanded greater independence from the United States. On the other hand, the rulers of some nations have asked the United States for additional economic and military aid because of the rise in violence among their citizens demanding reforms.

The United States has taken several steps to relieve tensions in the area. In 1977, for example, the United

U.S. President Theodore Roosevelt, *centre,* visited the construction site of the Panama Canal in 1906. Panama had given the United States control of the Canal Zone in 1903.

U.S. President Jimmy Carter, *left,* at a 1977 ceremony, signed a treaty that will give Panama complete control of the Panama Canal beginning on Dec. 31, 1999.

States and Panama signed a treaty that will give Panama total control of the Panama Canal beginning on Dec. 31, 1999.

Political unrest. During the early and mid-1900's, widespread protests broke out in many Latin-American countries as the people demanded major economic and political reforms. Revolutions overthrew a number of dictators. However, the end of dictatorship did not bring about stability or more representative government in many of the countries.

During the mid-1900's, violence frequently erupted as rival political groups struggled for power. Bombings, kidnappings, and assassinations occurred in numerous countries. Military leaders took control of several Latin-American governments. These leaders often violated the people's civil rights, claiming it was necessary in order to achieve stability and reforms. They closed universities, shut down newspapers, established strict censorship laws, and jailed thousands of people without trial as suspected terrorists.

One of the most significant political developments in Latin America occurred in 1959. That year, Fidel Castro led a revolution in Cuba that overthrew the military dictatorship of Fulgencio Batista. Castro established a Communist dictatorship and became closely allied with the Soviet Union. He pledged to help Communist rebels in other Latin-American countries gain power.

After the Castro revolution, activity by Communist and other leftist organizations increased greatly in Latin America. In 1979, a revolution led by members of the Sandinista National Liberation Front, a Communist group supported by Cuba, overthrew Nicaragua's dictator, Anastasio Somoza Debayle. The group, usually called the Sandinistas, took control of the government.

Recent developments. Latin America's economy grew during the 1960's and early 1970's. By the late 1970's, however, several factors slowed that growth. Prices rose sharply for such needed imports as petroleum, chemical fertilizers, and industrial machinery. At the same time, the prices that Latin-American nations received for their agricultural and mineral exports dropped. Many countries had to borrow huge sums of money at high interest rates to finance their development. Some of these nations have had trouble raising the money they needed to repay their loans.

Civil war and protest have sometimes shattered the peace in Latin America. Armoured vehicles rumble down a street in El Salvador, *above,* where government troops fight leftist rebels.

Fidel Castro waves to crowds in Havana, Cuba, in 1959 after leading a successful revolution against the dictator Fulgencio Batista. Under Castro, Cuba became a Communist dictatorship.

In the 1980's, protests against military governments grew in several Latin-American countries. As a result, civilian governments elected by the people have replaced military governments in such countries as Argentina, Brazil, and Chile. In 1990, elections were held in Nicaragua, and the Sandinistas lost control of the government to non-Communists.

Today, Latin America faces many serious social, economic, and political problems. The gap between the rich and the poor continues to widen. Millions of Latin Americans live in miserable poverty. The region's rapidly increasing population makes it difficult for countries to provide enough jobs, housing, and vital services for their people. Growing demands for social and economic reforms continue, and have sometimes exploded into violent protests and civil wars.

Study aids

Related articles in *World Book* include:

Biographies

Alvarado, Pedro de
Balboa, Vasco Núñez de
Bolívar, Simón
Cabral, Pedro Álvarez
Columbus, Christopher
Cortés, Hernando
Hidalgo y Costilla, Miguel
Magellan, Ferdinand
Miranda, Francisco de
O'Higgins (family)
Pedro (emperors)
Pizarro, Francisco
San Martín, José de
Toussaint L'Ouverture
Vespucci, Amerigo

Countries and other political units

See the separate articles on Latin-American countries and other political units listed in the *table* with this article. See also the following articles:

Central America
North America
South America
West Indies

History

- Aztec
- Exploration
- Guantánamo
- Inca
- Line of Demarcation
- Maya
- Monroe Doctrine
- Organization of American States
- Pan-American Conferences
- Pan American Union
- Panama Canal (History)
- Roosevelt, Franklin D. (Good Neighbour Policy)
- Roosevelt, Theodore
- South America
- Spanish-American War

Other related articles

- Bullfighting
- Christmas (In Latin America)
- Clothing (pictures)
- Common market
- Gaucho
- Indian, American
- Latin-American literature
- Library (Latin America)
- Pan American Highway
- Sculpture (American Indian)

Outline

- **I. People**
  - A. Population
  - B. Ancestry
  - C. Languages
- **II. Way of life**
  - A. City life
  - B. Rural life
  - C. Family life
  - D. Clothing
  - E. Food and drink
  - F. Recreation
  - G. Religion
  - H. Education
- **III. The arts**
  - A. Architecture
  - B. Literature
  - C. Painting
  - D. Sculpture
  - E. Music
  - F. Dancing
  - G. Handicrafts
- **IV. History**

Questions

How do city and country life differ in Latin America?
What are *mestizos*? *Mulattoes*?
How does the Roman Catholic Church influence the daily lives of Latin Americans in some countries?
What was the Line of Demarcation?
Why do many Latin-American children fail to complete primary school?
Why did the Indian population decline after European colonists arrived in Latin America?
What are *artes populares*?
Why have millions of rural Latin Americans moved to urban areas?
What were the main reasons Latin-American colonists wanted independence from their European rulers?
Why do numerous Latin Americans distrust the United States?

Latin-American literature consists of the literature of the Spanish-speaking countries of the Western Hemisphere, of Puerto Rico, and of Portuguese-speaking Brazil. For the historical background of the literature, see Latin America.

Colonial literature

The colonial period began with the first Spanish and Portuguese explorations of the New World in the late 1400's. It ended with the colonial wars for independence more than 300 years later. The earliest colonial literature consisted mostly of chronicles and narratives written by soldiers and missionaries who described their amazing encounters with new landscapes and civilizations. The authors mixed fantasy with realism in describing their adventures and contacts with unfamiliar peoples, customs, animals, and plants.

Hernando Cortés, the Spanish conqueror of the Aztec empire, wrote a series of five reports for King Charles I of Spain. These accounts, known as the *Five Letters* (1519-1526), are a gripping and detailed presentation of his campaign. Bernal Díaz del Castillo, who served in the Aztec campaigns led by Cortés, wrote a lively chronicle, *The True History of the Conquest of New Spain* (1522).

Many works dealt with the period of conquest. In *The Devastation of the Indies: a Brief Account* (1552), the Dominican missionary Bartolomé de Las Casas criticized the brutal treatment of the Indians by the Europeans. Garcilaso de la Vega's *Royal Commentaries* (1609) dramatized the history of the Inca empire. The greatest poem of the time was *La Araucana* (1569-1589) by Alonso de Ercilla y Zúñiga. It recounted the bravery of the Chilean Indians who resisted the Spanish invaders. The first colonial poet to write in Portuguese was Bento Texeira Pinto. In his epic *Prosopopéia* (1601), he dealt with the individual and nature in the American environment.

A new literary style called the *baroque* emerged during the second half of the 1600's. Baroque authors wrote in an ornate and artificial style and used cutting wit and intricate wordplay. The complex baroque style produced works that were often difficult to understand.

The leading writer of the baroque period was the Mexican nun Sor Juana Ines de la Cruz, who is generally considered the finest writer in colonial Latin-American literature. She wrote plays, satires, philosophical works, and various types of poetry.

Juan del Valle y Caviedes of Peru composed satirical poetry that criticized the corruption he saw in colonial society. Gregório de Matos of Brazil also wrote satirical poetry. The Brazilian poet Tomás Antônio Gonzaga wrote some of the finest lyric poetry in the Portuguese language, notably his love poem *Marília de Dirceu* (1792). The Brazilian writers José Basílio da Gama and José de Santa Rita de Durão continued the tradition of epic poetry. Da Gama's *Uruguay* (1769) describes the war between the European conquerors and the Paraguayan Indians. De Durão's *Caramurú* (1781) narrates the discovery and settlement of Brazil.

The 1800's

Most of the Latin-American colonies began fighting for their independence from Spain and Portugal in the early 1800's. Hostility toward the colonial powers led to the so-called Wars of Independence, which began in 1810 and lasted for about 16 years. The wars inspired writers to compose patriotic poetry and fiction that satirized the colonial powers. José Joaquín Fernández de Lizardi wrote perhaps the first Latin-American novel, *The Itching Parrot* (1816), a satirical story about the corrupt colonial society of Mexico City. José Joaquín Olmedo of Ecuador wrote the famous patriotic poem "Song to Bolívar" (1825).

Romanticism was a cultural movement that began in Europe in the late 1700's and spread to Latin America. Romanticism emphasized individualism and nationalism. It also stressed artistic freedom to pursue new subject matter and fresh literary forms.

José María Heredia of Cuba was one of Latin America's earliest romantic writers. He wrote the melancholy nature poem "On the Pyramid of Cholula" (1820). Some of the poetry of Andrés Bello of Venezuela has subtle romantic elements, especially "Ode to the Agriculture of the Torrid Zone" (1826).

A type of romanticism called *nativism* developed in the 1800's. Nativist writers dealt with the distinctive regional characteristics of their countries. Esteban Echeverría of Argentina expressed his love of the vast

Argentine *Pampas* (plains) in his lyric poetry. Gaucho literature became especially popular. Gauchos were nomadic cowboys who were depicted as romantic outlaws. José Hernández of Argentina wrote the best-known example of gaucho literature, the epic poem *Martín Fierro* (1872, 1879). This work recounts the gaucho hero's lonely life, his encounters with Indians, and the harsh treatment he receives from an insensitive government.

The novel flourished during the romantic period. Jorge Isaacs of Colombia wrote *María* (1867), a sentimental love story that remains one of the most popular works in Latin-American literature. José Marmol of Argentina and Ignacio Manuel Altamirano of Mexico were liberal writers who wrote novels that opposed political injustice. Another political writer, Domingo Faustino Sarmiento of Argentina, mixed essays and fiction in *Civilization and Barbarism: Life of Juan Facundo Quiroga* (1845).

The romantic concept of the *noble savage* became a popular theme during the 1800's. To the romantics, non-Europeans such as the Indians were superior because they were not corrupted by European civilization. In Brazil, the poetry of Antônio Gonçalves Dias won praise for its glorified portrayal of the Indians. Indians were the heroes of the novels *O Guarani* (1857) by José de Alencar of Brazil and *Cumandá* (1879) by Juan León Mera of Ecuador and of the epic poem *Tabaré* (1888) by Juan Zorrilla de San Martín of Uruguay.

The Peruvian writer Ricardo Palma created a unique literary form called *tradición.* The form consisted of prose sketches that combined history, legend, gossip, stories, and humour. Palma's sketches were collected in *Peruvian Traditions,* published from 1872 to 1910.

Realism was a literary movement that developed in the late 1800's. Writers tried to capture external reality in a detailed and objective way. Their works showed how human beings are influenced by their social environment. Some writers wrote in a more severe and pessimistic form of realism called *naturalism.*

The leading Latin-American realists included the novelists Alberto Blest Gana and Baldomero Lillo of Chile, Clorinda Matto de Turner of Peru, Eugenio Cambaceres of Argentina, and Federico Gamboa of Mexico. Probably the most important realist was the Brazilian novelist Joaquim Maria Machado de Assis. His best-known novels, *Epitaph of a Small Winner* (1881) and *Dom Casmurro* (1900), show a mastery of characterization and narrative technique.

A number of writers emphasized the local customs, habits, and speech of Spanish America's regions in sketches, short stories, and novels. Their works became known as *costumbrismo.* The leading costumbrista authors included Javier de Viana of Uruguay, Roberto J. Payró of Argentina, and Tomás Carrasquilla of Colombia. All these writers emphasized descriptions of local rural landscapes and types in their stories. The best-known realist playwright was Florencio Sánchez of Argentina, who wrote plays dealing with human conflict in rural Argentina.

Modernism, which lasted from about 1888 to 1910, was one of the most significant literary periods in Latin-American literature. The most important writers were poets. The Nicaraguan poet Rubén Darío gave modernism its form. Darío believed that poetry should avoid messages. Instead, poetry should strive to attain beauty in its purest form while liberating verse from traditional styles. In their search for the unusual, poets turned to such exotic sources as Greek, Oriental, and Nordic mythology. Darío's book of poems, *Azul* (1888), marked the beginning of modernism. Leopoldo Lugones of Argentina was another leading poet of the period.

José Enrique Rodó, a Uruguayan essayist, exerted almost as much influence as Darío. Rodó's essay *Ariel* (1900) became a landmark of Latin-American thought. Rodó appealed to the young people of Latin America to strive for idealism and high spiritual goals, both of which were being threatened by modern materialism. José Martí of Cuba was another influential Latin-American intellectual. He was a celebrated journalist, essayist, and poet who was honoured as a patriot after he died fighting for Cuban independence.

The 1900's

The early 1900's. A group of women poets won praise during the early 1900's. Many of their poems dealt with love and womanhood in a society dominated by men. One of the poets, Gabriela Mistral of Chile, won the 1945 Nobel Prize for literature. She was the first Latin-American writer to receive the prize. Other leading woman poets were Delmira Agustini and Juana de Ibarbourou of Uruguay and Alfonsina Storni of Argentina.

Novelists took a fresh interest in regional themes. José Eustasio Rivera of Colombia portrayed the Amazon rain forest as a place of beauty and terror in *The Vortex* (1924). Rómulo Gallegos wrote about the tropical plains of Venezuela in *Doña Bárbara* (1929). Ricardo Güiraldes of Argentina told the adventures of a boy who receives spiritual guidance from a gaucho in *Don Segundo Sombra* (1926). José Lins do Rego's "sugarcane cycle" of novels (1932-1943) recaptures the author's childhood on a sugar plantation in Brazil.

Many regional novels explored social and political problems. *Rebellion in the Backlands* (1902) by Euclides da Cunha gives a dramatic picture of a military conflict between poverty-stricken peasants and government forces. The Mexican revolution of 1910 inspired Mariano Azuela's novel *The Underdogs* (1916). Graciliano Ramos' *Barren Lives* (1938) and Jorge Amado's *The Violent Land* (1942) criticized social conditions in Brazil. The mistreatment of Indians is portrayed in *Huasipungo* (1934) by Jorge Icaza of Ecuador, *El indio* (1935) by Gregorio López y Fuentes of Mexico, and *Yawar Fiesta* (1940) by José María Arguedas of Peru.

Several Latin-American poets of the 1920's experimented with form and technique. The most important of these poets were Vicente Huidobro and Pablo Neruda of Chile, César Vallejo of Peru, Mario de Andrade of Brazil, and Jorge Luis Borges of Argentina. They rejected traditional forms to create poetry with unusual imagery. Such poems were intended to reveal the subconscious mind. Andrade's *Hallucinated City* (1922) is an example of the experimental poetry of the time.

The mid-1900's. A variety of themes dominated the literature of the mid-1900's. A sense of isolation and lack of human communication was expressed by Eduardo Mallea of Argentina in his novels *Bay of Silence* (1940) and *All Green Shall Perish* (1941). Ciro Alegría of Peru wrote a novel of social protest about the abuses of Peruvian Indians in *Broad and Alien Is the World* (1941). Jorge Luis Borges wrote philosophical short stories of fantasy in *Ficciones* (1944).

During the mid-1940's, writers combined authentic subject matter, varied themes, and experiments in language to produce the "new novel." Novelists became more aware of their cultural identity, but they avoided extreme expressions of nationalism in their works. The best-known examples of the "new novel" included *El señor presidente* (1946) by Miguel Angel Asturias of Guatemala, *The Edge of the Storm* (1947) by Augustín Yáñez of Mexico, *Adán Buenosayres* (1948) by Leopoldo Marechal of Argentina, *Born Guilty* (1951) by Manuel Rojas of Chile, *The Lost Steps* (1953) by Alejo Carpentier of Cuba, and *Pedro Páramo* (1955) by Juan Rulfo of Mexico.

The leading Latin-American poet in the mid-1900's was the Mexican Octavio Paz. Much of his verse deals with Mexican identity and history. He also wrote essays on literary criticism, art, and politics.

Recent developments. The most important development in Latin-American literature since the 1950's has been the sudden and unprecedented international attention enjoyed by novelists. The large number of important novels produced by these writers has been called the "boom." The original boom novelists were Carlos Fuentes of Mexico, Julio Cortázar of Argentina, Mario Vargas Llosa of Peru, and Gabriel García Márquez of Colombia. All four use literary invention in their narratives to express their cultural heritage. They experimented with language and structure, often injecting fantasy and fragmenting time and space. The boom produced a style known as "magical realism," which blended dreams and magic with everyday reality.

Carlos Fuentes' major novels provide a panorama of life in modern Mexico. His major works include *Where the Air Is Clear* (1958) and *The Death of Artemio Cruz* (1962). Cortázar's most influential novel is *Hopscotch* (1963), which experiments with narrative technique and revolts against traditional uses of language. Many critics consider Cortázar's short stories to be even better than his novels. Fantasy, allegory, and philosophy characterize such story collections as *A Change of Light* (1974).

Octavio Paz

The boom novelist Vargas Llosa writes about modern Peruvian society. His most ambitious work, *The War of the End of the World* (1981), is a historical novel of high adventure based on Euclides da Cunha's *Rebellion in the Backlands.*

The most famous boom novelist is Gabriel García Márquez, who won the 1982 Nobel Prize for literature. His novel *One Hundred Years of Solitude* (1967) ranks as a landmark of Latin-American fiction. The novel contains much historical fact, but the author also includes fantasy, extraordinary characters, bizarre events, suspense, and unusual humour. García Márquez maintained his international reputation with such works as *The Autumn of the Patriarch* (1975), *Chronicle of a Death Foretold* (1981), and *Love in the Time of Cholera* (1986).

Related articles in *World Book* include:

Amado, Jorge
Asturias, Miguel Angel
Borges, Jorge Luis
Cunha, Euclides da
Darío, Rubén
Fuentes, Carlos
García Márquez, Gabriel José
Gaucho
Machado de Assis, Joaquim Maria
Martí, José Julián
Mistral, Gabriela
Neruda, Pablo
Paz, Octavio
Rodó, José Enrique

Latin language was the principal language of western Europe for hundreds of years. It was the language of the Roman Empire, and Roman soldiers and traders took it wherever they went. Latin, because of its precise expression, was a perfect language for law and government. As used by the Roman poet Virgil and other literary masters, Latin achieved a dignity and tone rarely equalled by any other language.

Latin has not been a spoken language since the end of the Middle Ages in the early 1500's. However, many Latin words helped shape modern scientific and legal terms. For example, the word *gravity* comes from the Latin word *gravis,* meaning *heavy.* The word *verdict* comes from the Latin words *verus,* meaning *truth,* and *dicere,* meaning *to speak.* The Roman Catholic Church still considers Latin its official language, though Mass is celebrated in the tongue of the local community.

Structure

Alphabet. The Latin alphabet was borrowed from the Greeks, probably through the Etruscans, an ancient people who lived in Italy. In classical times, Latin had 23 letters, but it lacked the *j, u,* and *w* of the English language. The Roman alphabet became the basis of most modern alphabets. See the *World Book* articles on **Alphabet** and on each letter of the English alphabet.

Grammar. Latin belongs to the Indo-European family of languages and is therefore closely related to the Celtic, Germanic, Greek, Sanskrit, and Slavic languages. Like Greek, Latin is highly *inflected*—that is, changes in meaning are often indicated by changes in word endings. For an example of the inflections of a Latin noun, see **Case** (Cases in Latin).

Development

Latin was one of several related languages of ancient Italy. Others, such as Oscan and Umbrian, died out as the influence of Latin spread.

In ancient times. Examples of the earliest Latin, which is sometimes called *preliterary Latin,* were preserved in inscriptions and religious texts. During the 200's and 100's B.C., Latin changed from a spoken language to a highly developed literary tongue. It reached its highest level of development in the Golden Age of Latin literature, from 106 B.C. to A.D. 14. Works of prose by Julius Caesar and Cicero, and the poetry of Virgil and Horace, set standards of excellence for future writers. See **Latin literature** (The Golden Age).

A *vernacular* (common) form of Latin developed at the same time as literary Latin. It underwent many changes after the Golden Age. Inflections were simplified, and word order became more regular. The spread of Christianity, plus invasions by Germanic tribes, contributed to the fall of the West Roman Empire in the 300's and 400's.

Some unusual Latin derivations

antler, from *antocularis,* before the eye
bugle, from *buculus,* young bull
chapel, from *cappella,* cloak
hoosegow, from *judicare,* to judge (through the Spanish *juzgado*)
pay, from *pacare,* to make peace
shambles, from *scamellum,* bench
soldier, from *solidus,* gold coin
sullen, from *solus,* alone
travel, from *trepalium,* instrument of torture (through the French *travailler*)
villain, from *villanus,* farm hand

The Christians and the invaders changed Latin further by adding new words and meanings to the language.

During the Middle Ages, the spoken Latin of the late Roman Empire developed into the Romance languages, including French, Italian, Portuguese, Romanian, and Spanish (see **Romance languages**). At this time, a form of literary Latin called *Medieval Latin* was the language of the Christian church and of education. It ranked as an international tongue and was used by scholars in universities and religious schools throughout western Europe.

Latin today

In schools. Latin has been taught in schools since the Middle Ages, though its popularity has declined during the 1900's. Many educators believe the study of Latin trains a student to think precisely and to understand grammatical relationships. For example, students of Latin can derive the meanings of difficult English words based on their knowledge of Latin roots. In addition, a knowledge of Latin aids students in learning modern languages, especially the Romance languages.

Latin and English. Scholars estimate that about half of all English words in current use are of Latin origin. Most of them were borrowed from Old French, and reflect forms and meanings that Latin words had acquired in that language. But scholars also borrowed many words directly from Latin. Consequently, we have such words as *loyal* and *legal,* both from the Latin *legalis,* meaning *legal.* The form *loyal* was borrowed from the French, with its new feudal meaning.

The vast majority of English abstract words are Latin in origin. When we speak of the "power of liberty," the "spirit of independence," or the "virtue of charity," the two important words in each phrase are Latin. Many English scientific terms come from Latin. The title of every rank in the army, from *private* to *general,* has a Latin origin. Some common Latin idioms remain unchanged in English, including such phrases as *persona non grata, ad infinitum,* and *P.S.* (*post scriptum*). The richness and variety of the English language owe much to the contributions of Latin.

Latin literature includes the essays, histories, poems, plays, and other writings of the ancient Romans. In many ways, it seems to be a continuation of Greek literature, using many of the same forms. However, Latin literature also mirrored the life and history of ancient Rome.

Characteristics of Latin literature

Much Latin writing reflects the great interest the Romans had in *rhetoric,* the art of speaking and persuading. Public speaking had great importance for educated Romans, because most of them hoped for successful political careers. When Rome was a republic, effective speaking often determined who would be elected or what bills would be passed. After Rome became an empire, the ability to impress and persuade people by the spoken word lost much of its importance. But training in rhetoric continued to flourish and to affect styles of writing. A large part of rhetoric consists of the ability to present a familiar idea in a striking new manner that attracts attention. Latin authors became masters of this art of variety.

Language and form. Latin is a highly *inflected* language, with many grammatical forms for various words. As a result, it can be used with a pithiness and brevity unknown in English (see **Inflection**). It also lends itself to elaboration, because its tight syntax holds even the longest and most complex sentence together as a logical unit. Latin can be used with striking conciseness, as in the works of Sallust and Tacitus. Or it can have wide, sweeping phrases, as in the works of Livy and the speeches of Cicero.

Latin lacks the rich poetic vocabulary that marks ancient Greek poetry. Some earlier Latin poets tried to make up for this deficiency by creating new compound words, as the Greeks had done. But Roman writers seldom invented words. Except in epic poetry, they tended to use a familiar vocabulary, giving it poetic value by imaginative combinations of words and by rich sound effects. Rome's leading poets had great technical skill in the choice and arrangement of language. They also had an intimate knowledge of the Greek poets, whose themes appear in almost all Roman literature.

Latin moves with impressive dignity in the writings of Lucretius, Cicero, or Virgil. It reflects the seriousness and sense of responsibility that characterized the ruling class of Rome during the great years of the republic. But the Romans could also relax and allow what Horace called the "Italian vinegar" in their systems to pour forth in wit and satire.

Latin in translation. The best Latin literature has been translated into most major languages. Until the 1900's, the majority of educated people in the West knew at least some Latin. Today, fewer people are familiar with the language, but an increasing number enjoy Latin literature through translations.

Some translators *paraphrase*—that is, they try to keep the beauty and spirit of the original work without providing the exact meaning of each phrase. During the 1600's and 1700's, a number of English poets translated much Latin poetry by paraphrasing. Perhaps the outstanding example was John Dryden's English version of the poems of Virgil, published in 1697.

Other translators provide literal translations, trying to imitate exactly the writings of Latin authors. However, these translations lose much of the beauty and style that made the originals such works of art. The chief value of literal translations lies in helping students read Latin more easily.

Early Latin literature

Formal Latin literature began in 240 B.C., when a Roman audience saw a Latin version of a Greek play. The adaptor was Livius Andronicus, a Greek who had been brought to Rome as a prisoner of war in 272 B.C. Andronicus also translated Homer's Greek epic the *Odyssey* into an old type of Latin verse called *Saturnian.* The first Latin poet to write on a Roman theme was Gnaeus Naevius during the 200's B.C. He composed an epic poem about the first Punic War, in which he had fought. Naevius' dramas were mainly reworkings of Greek originals, but he also created tragedies based on Roman myths and history.

Other epic poets followed Naevius. Quintus Ennius wrote a historical epic, the *Annals* (soon after 200 B.C.), describing Roman history from the founding of Rome to his own time. He adopted Greek dactylic hexameter, which became the standard verse form for Roman epics. He also became famous for his tragic dramas. In this field his most distinguished successors were Marcus Pacuvius and Lucius Accius. These three writers rarely used episodes from Roman history. Instead, they wrote Latin versions of tragic themes that the Greeks had already handled. But even when they copied the Greeks, they did not translate slavishly. Only fragments of their plays have survived.

We know much more about early Latin comedy, because we have 20 complete plays by Plautus and 6 by Terence. These men modelled their comedies on Greek plays known as New Comedy. But they treated the plots and wording of the originals freely. Plautus scattered songs through his plays and increased the humour with puns and jokes, plus comic actions by the actors. Terence's plays were more polite in tone, dealing with domestic situations. His works provided the chief inspiration for French and English comedies of the 1600's.

The prose of the period is best known through *On Agriculture* (160 B.C.) by Cato the Elder. Cato also wrote the first Latin history of Rome and of other Italian cities. In addition, he was the first Roman to put his political speeches in writing as a means of influencing public opinion.

Early Latin literature ended with Gaius Lucilius, who created a new kind of poetry in his 30 books of *Satires* (100's B.C.). He wrote in an easy, conversational tone about books, food, friends, and current events. In the early A.D. 100's, Juvenal perfected the biting form of satire that has served as a model for many later writers. See **Satire.**

The Golden Age

Latin literature was at its best from 81 B.C. to A.D. 17. This period began with the first known speech of Cicero and ended with the death of Ovid.

The age of Cicero. Cicero was the greatest master of Latin prose. He dominated Latin literature from about 80 B.C. until his death in 43 B.C. Cicero's many writings can be divided into four groups: (1) letters, (2) rhetorical treatises, (3) philosophical works, and (4) orations. His letters provide detailed information about an important period in Roman history and offer a vivid picture of the public and private life among the Roman governing class. Cicero's works on oratory are our most valuable Latin sources for ancient theories on education and rhetoric. His philosophical works were the basis of moral philosophy during the Middle Ages. His speeches inspired many European political leaders and the founders of the United States.

Julius Caesar and Sallust were outstanding historical writers of Cicero's time. Caesar wrote commentaries on the Gallic and civil wars in a straightforward style to justify his actions as a general. Sallust adopted an abrupt, pointed style in his historical works. He wrote brilliant descriptions of people and their motives.

The birth of lyric poetry in Latin occurred during the same period. The short love lyrics of Catullus have never been surpassed in emotional intensity. Catullus also wrote masterful poems that attacked his enemies. In his longer poems, he suggested beautiful images in rich, delicate language.

In contrast, the poet Lucretius undertook to interpret the ideas of the Greek philosopher Epicurus. Lucretius' work *De rerum natura* (55 B.C.) contains many majestic passages. It is a triumph of poetic genius over unpoetic matter.

The most learned writer of the period was Varro. He wrote about a remarkable variety of subjects, from religion to poetry. Unfortunately, only his writings on agriculture and the Latin language survive in their complete form.

The Augustan Age. The emperor Augustus took a personal interest in the literary works produced during his years of power from 27 B.C. to A.D. 14. This period is sometimes called the *Golden Age of Latin Literature.* Virgil published his pastoral *Eclogues;* the *Georgics,* perhaps the most beautiful poem ever written about country life; and the *Aeneid,* an epic poem describing the events that led to the creation of Rome. Virgil told how the Trojan hero Aeneas became the ancestor of the Roman people. Virgil also provided divine justification for Roman rule over the world. Although Virgil died before he could put the finishing touches to his poem, it was soon recognized as the greatest work of Latin literature. Critics still agree on this judgment.

Virgil's friend Horace wrote *Epodes, Odes, Satires* and *Epistles.* The perfection of the *Odes* in content, form, and style has charmed readers for hundreds of years. The *Satires* and *Epistles* discuss ethical and literary problems in an urbane, witty manner. Horace's *Art of Poetry,* probably published as a separate work, greatly influenced later poetic theories. It stated the basic rules of classical writing as the Romans understood them. After Virgil died, Horace was the leading poet of Rome.

The Latin elegy reached its highest development in the works of Tibullus, Propertius, and Ovid. Most of this poetry is concerned with love (see **Elegy**). Ovid also wrote the *Fasti,* which describes Roman festivals and their legendary origins. Ovid's greatest work, the *Metamorphoses* weaves various myths into a fast-paced, fascinating story. Ovid was a witty writer who excelled in creating lively and passionate characters. The *Metamorphoses* was the best-known source of Roman mythology throughout the Middle Ages and the Renaissance. It inspired many poets, painters, and composers.

In prose, Livy produced a history of the Roman people in 142 books. Only 35 survive, but they are a major source of information on Rome.

Later Latin literature

The Imperial Period. From the death of Augustus in A.D. 14 until about 200, Roman authors emphasized style and tried new and startling ways of expression. During the reign of Nero from 54 to 68, the Stoic philosopher Seneca wrote a number of dialogues and letters on such moral themes as mercy and generosity. In his *Natural Questions,* Seneca analysed earthquakes, floods, and storms. Seneca's tragedies greatly influenced the growth of tragic drama in Europe. His nephew Lucan wrote the *Pharsalia* (about 60), an epic poem describing the civil war between Caesar and Pompey. The *Satyricon* (about 60) by Petronius was the first Latin novel. Only fragments of the complete work survive. It describes the adventures of various low-class characters in absurd, extravagant, and dangerous situations, often in the world of petty crime.

Epic poems included the *Argonautica* of Valerius Flaccus, the *Thebaid* of Statius, and the *Punica* of Silius Italicus. At the hands of Martial, the epigram achieved the stinging quality still associated with it. Juvenal brilliantly satirized vice.

Among prose writers, the historian Tacitus probably deserves first place. He painted an unforgettably dark picture of the early empire in his *Histories* and *Annals,* both written in the early 100's. His contemporary Suetonius wrote biographies of the 12 Roman rulers from Julius Caesar to Domitian. The letters of Pliny the Younger described Roman life of the period. Quintilian composed the most complete work on ancient education that we possess. Important works from the 100's include the *Attic Nights* of Aulus Gellius, a collection of anecdotes and reports of literary discussions among his friends; and the letters of the orator Fronto to Marcus Aurelius. The most famous work of the period was *Metamorphoses,* also called *The Golden Ass,* by Lucius Apuleius. This novel concerns a young man who is accidentally changed into a donkey. The story is filled with colourful tales of love and witchcraft.

Later periods. Pagan Latin literature showed a final burst of vitality in the late 200's and 400's. Ammianus Marcellinus in history, Symmachus in oratory, and Ausonius and Rutilius in poetry all wrote with great talent. The *Mosella* by Ausonius had a modernism of feeling that indicates effectively the end of classical literature as such.

At the same time, other men laid the foundations of Christian Latin literature during the 300's and 400's. They included the church fathers Augustine, Jerome, and Ambrose, and the first great Christian poet, Prudentius.

Related articles in *World Book* include:

Ambrose, Saint
Apuleius, Lucius
Augustine, Saint
Caesar, Julius
Cato
Catullus, Gaius Valerius
Cicero, Marcus Tulli
Classicism (Rome)
Horace
Jerome, Saint
Juvenal
Livy
Lucretius
Marcus Aurelius
Martial
Ovid
Petronius
Plautus
Pliny
Quintilian
Seneca, Lucius Annaeus
Suetonius
Tacitus, Cornelius
Terence
Virgil

Latitude describes the position of a point on the earth's surface in relation to the equator. Latitude is one of the two grid *coordinates* that can be used to locate any point on the earth. The other coordinate is longitude.

The latitude of a point is measured in terms of its distance from the equator toward one of the earth's poles. Latitude is measured in degrees. Any point on the equator has a latitude of zero degrees (written 0°). The North Pole has a latitude of 90° *north* and the South Pole has a latitude of 90° *south.* These dimensions are sometimes written $+90°$ and $-90°$. Degrees of latitude are divided into 60 *minutes* ('), and the minutes each consist of 60 *seconds* (").

All points on the earth's surface that have the same latitude lie on an imaginary circle called a *parallel of latitude.* The distance between two parallels that are 1° apart is about 60 *nautical* (sea or air) miles, or 69 *statute* (land) miles or 111 kilometres. This length of 1° of latitude varies from 59.7 nautical miles near the equator to 60.3 nautical miles near the poles. The variation results because the earth is not a perfect sphere. A difference in latitude of 1 minute equals about 1 nautical mile.

See also **Longitude; Equator; Map; Climate** (Differences in latitude); **Star** (Measuring direction and position).

Latium was an area in the central part of ancient Italy. It was located in the same general area as the present province of Latium (see **Italy** [political map]). Its chief cities fought the Romans from 340 to 338 B.C. The Romans won, and Latium became part of the Roman territory. The people were given partial Roman citizenship. The Latin language was named after Latium.

Latrobe, Benjamin Henry (1764-1820), was the first important professionally trained architect to practise in the United States. He established the neoclassical style for the new federal government buildings in Washington, D.C. He also introduced the Greek Revival style into the United States. The Bank of Pennsylvania (1800), designed by Latrobe, became the first building in the nation to extensively feature elements of ancient Greek architecture.

Latrobe was born near Leeds, England. He began to practise architecture in England but moved to the United States in 1796. He designed the Bank of Pennsylvania in Philadelphia and the Philadelphia waterworks (1801), which featured a steam engine to raise the water level of the Schuylkill River.

In 1803, President Thomas Jefferson appointed Latrobe Surveyor of the Public Buildings of the United States. From 1803 to 1812, Latrobe worked on the U.S. Capitol in Washington, D.C., and was responsible for much of its design. He also designed the U.S. Customs House (1809) in New Orleans as well as many private houses. He also helped Jefferson with the plans for the University of Virginia. From 1815 to 1817, Latrobe directed the reconstruction of the Capitol and other buildings that had been destroyed during the War of 1812. Latrobe's masterpiece is the Basilica of the Assumption (1821) in Baltimore.

La Trobe, Charles Joseph (1801-1875), became superintendent of the Port Phillip district in Australia in 1839. The settlement was then governed as part of New South Wales. La Trobe advocated that it should be separated from New South Wales. In 1851, the Port Phillip district became the separate colony of Victoria. La Trobe was lieutenant governor of the new colony from 1851 to 1854. He did much for the growing colony. He established a firm system of local government. When he attempted to introduce a system of licence fees for gold mining, many miners revolted against the system. La Trobe was born and educated in London.

Brown coal is easily mined by the opencast method in Australia's La Trobe Valley in Victoria. The excavated coal passes along a conveyor to the rear of the machine, from where it is transported to nearby power stations.

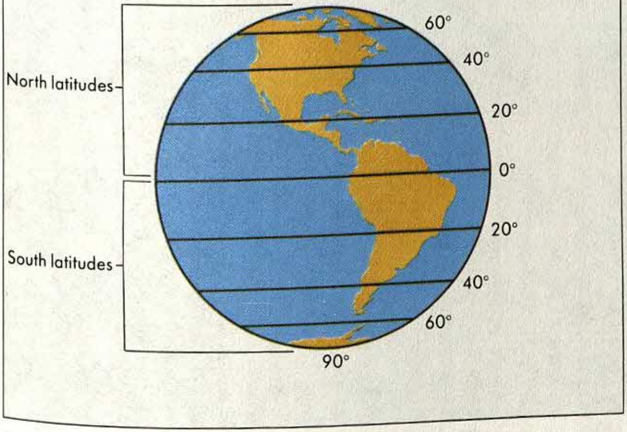
La Trobe Valley, in Victoria, is one of Australia's most productive river valleys. South of the La Trobe River, large deposits of brown coal have been developed as a major source of Victoria's electricity supply. Power stations in the valley produce nearly nine-tenths of the state's electricity. The La Trobe Valley's coal reserves exceed 17,000 million metric tons. The coal deposits are at least 60 metres thick and lie close to the surface. The seams can be worked without difficulty by opencast methods. Opencast mining scars the landscape, but the natural beauty can be restored.

The main towns in the valley are Moe, Morwell, and Traralgon. The main industries are power stations, briquette works, and pulp and paper mills.

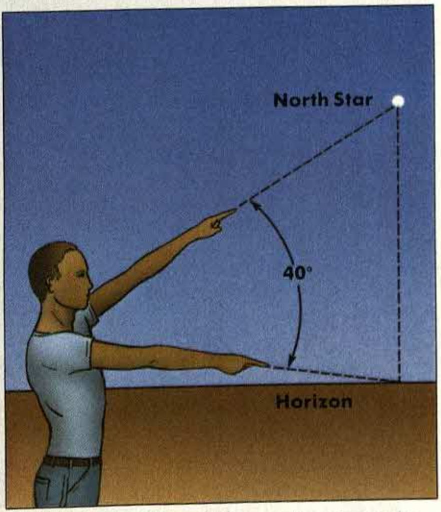
Latter Day Saints, Reorganized Church of Jesus Christ of, is a Christian denomination that originated in the United States in the early 1800's. The Reorganized Church bases its teachings on the Bible. Its scriptures include the *Book of Mormon,* a narrative of God's dealings with early peoples of the Western Hemisphere; and *Doctrine and Covenants,* a book of modern revelation and present-day church instruction. The Reorganized Church stresses personal virtue, family relations, and responsibility for neighbour and community.

The Reorganized Church traces its origin to the Church of Jesus Christ of Latter-day Saints, which was founded in 1830 in America by Joseph Smith, Jr., and his associates. After Smith and his brother were killed in

Latitude



Imagine a series of lines running around the earth parallel to the equator, *above.* These are lines of *latitude.* Every point on the earth's surface lies on such a line. It shows the position of that spot in relation to the equator.

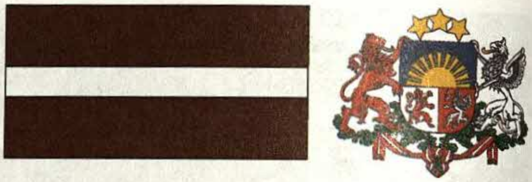


Point one arm at the North Star and the other at the horizon. The number of degrees of the angle between your arms is about the latitude where you are.

1844, many of the denomination's members accepted Brigham Young, one of Smith's followers, as the new leader of the church. But some people believed the leadership belonged to direct descendants of Smith. They began to reorganize in the 1850's, and adopted the denomination's present name in the 1860's. Church presidents of the Reorganized Church have all been direct descendants of Joseph Smith, Jr.

See also **Mormons; Smith, Joseph; Young, Brigham.**

Latter-day Saints, The Church of Jesus Christ of. See **Mormons.**



Symbols of Latvia. The Latvian flag dates back to the 1200's, when it served as a banner in battle for one of the original Latvian tribes. The symbols on Latvia's coat of arms—a rising sun, a red lion, and a silver *griffin* (mythological creature)—stand for the three original provinces of Latvia.

Latvia is a European nation that regained its independence in 1991, after more than 50 years of forced annexation to the Soviet Union. Latvia lies on the eastern shore of the Baltic Sea. It had been independent from 1918 to 1940, when the Soviet Union occupied it and made it one of the 15 republics of the Soviet Union.

Latvia covers 64,100 square kilometres. For Latvia's total population, see the *Facts in brief* table with this article. Riga is Latvia's capital and largest city. The country's formal name in Latvian, the official language, is *Latvijas Republika* (Republic of Latvia).

Government. Latvia has a 100-member legislature called the *Saeima.* The people elect the members to three-year terms. The legislature elects a president of Latvia to a term of two years and three months. The president serves as the ceremonial head of state and, with the approval of the legislature, chooses a prime minister and a cabinet. The prime minister heads the government. The prime minister and cabinet carry out government operations. For purposes of local government, Latvia is divided into 32 administrative regions.

People. About 52 per cent of the people of Latvia are Latvians, also called *Letts.* They are ethnically related to the Lithuanians and have their own culture and language. Russians, who speak the Russian language, make up about 34 per cent of the population of Latvia. Belarusians make up about 5 per cent of Latvia's population, Poles and Ukrainians each account for about 3 per cent, and Lithuanians and Jews together account for approximately 2 per cent. Most Jews who lived in Latvia during World War II (1939-1945) were killed by the Nazis.

The influence of the Latvians in their own country declined after the Soviet take-over in 1940. Previously, Latvians had made up about 75 per cent of the population. But many thousands were killed or driven from Latvia during World War II or sent to Siberia after the war. Others escaped to the West. Some Latvians were kept out of Latvia by the Russians. Thousands of Russians migrated into Latvia after World War II.

The Latvian language is one of the oldest in Europe. It is related to Sanskrit, a language of ancient India. After the Soviet take-over, all Latvians had to learn Russian, which the Soviet Union made the official language of Latvia.

During most of the era that Latvia was under Soviet

Riga, Latvia, lies on the Western Dvina River, south of the Gulf of Riga. It is the capital and largest city of Latvia. Riga is also an important shipping and industrial centre.

Facts in brief about Latvia

Capital: Riga.
Official Language: Latvian.
Official Name: Latvijas Republika (Republic of Latvia).
Area: 64,600 km². *Greatest distances*—north-south, 270 km; east-west, 450 km. *Coastline*—472 km.
Elevation: *Highest*—Gaizina Mountain, 311 m. *Lowest*—sea level along the coast.
Population: *Estimated 1996 population*—2,643,000; density, 41 people per km²; distribution, 73 per cent urban, 27 per cent rural. *1989 census*—2,680,029. *Estimated 2001 population*—2,646,000.
Chief products: *Agriculture*—barley, flax, oats, potatoes, rye. *Manufacturing*—electrical equipment, machinery, primary metals, food products, transportation equipment.
Money: *Currency unit*—lat. One lat = 100 santimi.

control, Russian was spoken as the first language in many government and business offices. It was also the primary language of most newspapers and TV programmes. However, in 1989, Latvian again became the land's official language. Since then, Latvian has been the first language in government and business offices, and in much of the media.

About 70 per cent of the Latvian people live in urban areas. Many of the city dwellers have flats in modern buildings constructed after World War II. Thousands of the city people moved from rural areas to the cities to work in various industries. Many of Latvia's rural people work on dairy and cattle farms.

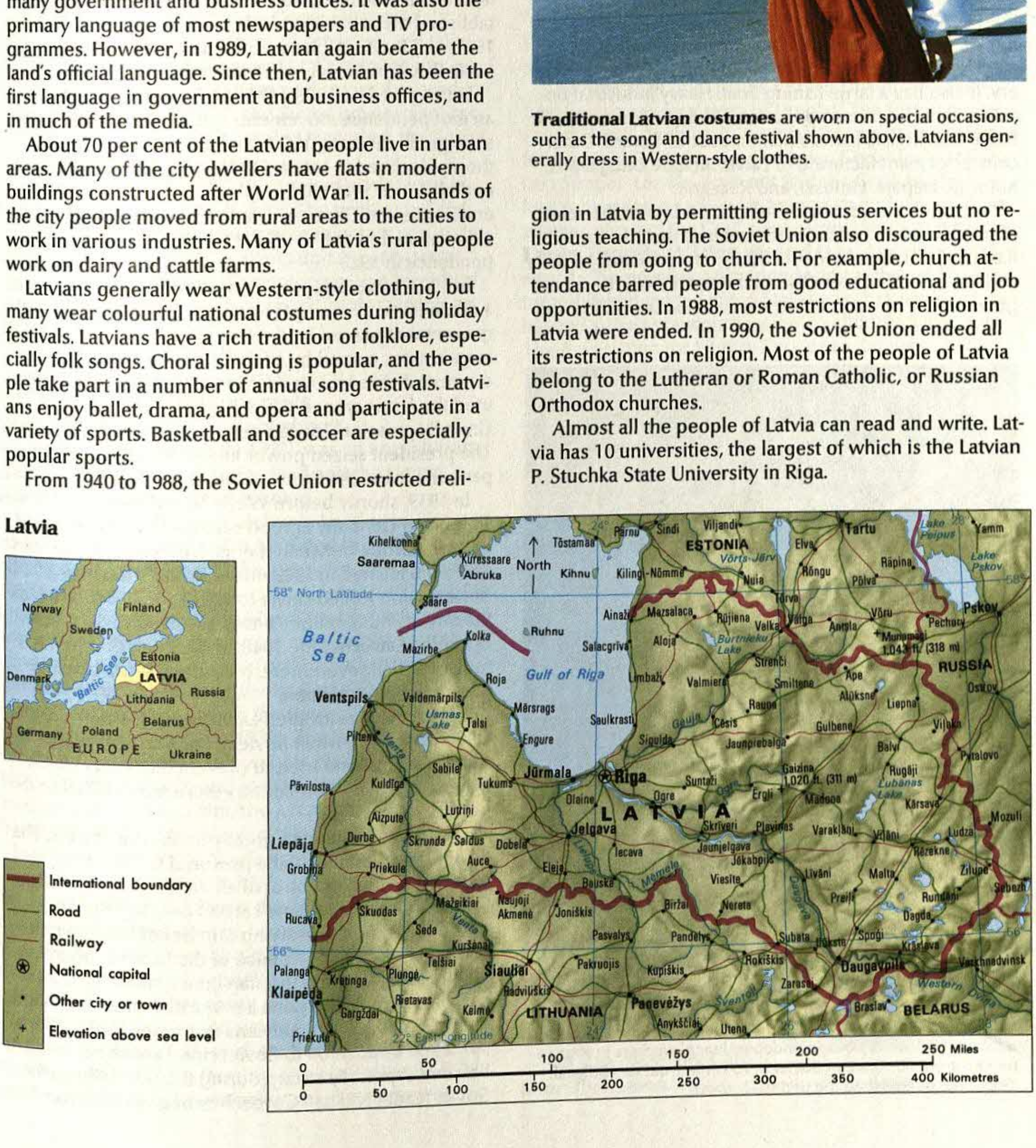
Latvians generally wear Western-style clothing, but many wear colourful national costumes during holiday festivals. Latvians have a rich tradition of folklore, especially folk songs. Choral singing is popular, and the people take part in a number of annual song festivals. Latvians enjoy ballet, drama, and opera and participate in a variety of sports. Basketball and soccer are especially popular sports.

Traditional Latvian costumes are worn on special occasions, such as the song and dance festival shown above. Latvians generally dress in Western-style clothes.

From 1940 to 1988, the Soviet Union restricted religion in Latvia by permitting religious services but no religious teaching. The Soviet Union also discouraged the people from going to church. For example, church attendance barred people from good educational and job opportunities. In 1988, most restrictions on religion in Latvia were ended. In 1990, the Soviet Union ended all its restrictions on religion. Most of the people of Latvia belong to the Lutheran or Roman Catholic, or Russian Orthodox churches.

Almost all the people of Latvia can read and write. Latvia has 10 universities, the largest of which is the Latvian P. Stuchka State University in Riga.

Latvia



Land and climate. Latvia, Estonia, and Lithuania are often called the Baltic States. They make up a region that forms part of the large coastal plain of northern Europe. Latvia consists chiefly of low hills and shallow valleys. It has many small lakes and swamps. Forests cover about 40 per cent of the land. The highest point is a hill in central Latvia that rises 312 metres above sea level.

Latvia's chief river is the Western Dvina (Daugava in Latvian). It flows northwest from Belarus through central Latvia and empties into the Gulf of Riga. Latvia has about 472 kilometres of coastline. Many of its beaches are popular resort areas.

Temperatures in Latvia range from about −7° to −3° C in January to 16° to 18° C in July. Latvia receives about 50 to 80 centimetres of rain annually.

Economy. Manufacturing makes up about three-quarters of the value of production in Latvia. Latvia's chief industries produce electronic equipment, household appliances, machinery, and processed foods and metals. Latvia produces buses, railway carriages, and steel, which is used to manufacture agricultural machinery. It also has a large fishing fleet. Heavy industrial development has caused pollution of lakes, rivers, and the Baltic Sea. Riga is Latvia's main industrial centre. Other centres of manufacturing in Latvia include Daugavpils, Kuldīga, Liepāja, Limbaži, and Rēzekne.

Agriculture accounts for less than a fifth of the value of production in Latvia. Farm products include barley, flax, oats, potatoes, and rye. Many farmers work on dairy and cattle farms. From 1940 to the late 1980's, the Soviet government owned Latvia's farms. In the late 1980's, the government began to allow people to start private farms and businesses. Today, most farms are privately owned.

Latvia gained independence from the Soviet Union in September 1991. Shortly before independence, workers in Riga removed a public statue of Soviet hero Lenin from its pedestal. They then demolished the pedestal, *above.*

History. People lived in what is now Latvia as early as 7000 or 8000 B.C. They were forced out about the time of Christ by invaders who became the ancestors of the Latvians. In time, these people established trade with Arabs, Estonians, Lithuanians, Romans, and other groups, and developed their own language and culture.

The Vikings raided Latvia during the A.D. 800's, and Russian forces attacked Latvia several times in the 900's. The Teutonic Knights, an organization of German crusaders, invaded Latvia during the 1200's. War between the Latvians and the Knights lasted until the late 1200's, when the Latvians surrendered. See **Teutonic Knights.**

For more than 200 years, the Teutonic Knights governed Latvia as part of a larger state called Livonia. But by 1562, most of Latvia had come under the rule of Poland and Lithuania. A German-ruled duchy was also established there. Sweden conquered northern Latvia in 1621, and Russia took control of this area in 1710. By 1800, Russia ruled all of Latvia.

During the late 1800's, the Latvians began to organize an independence movement. This movement became stronger in the early 1900's as Russian and German authority declined in Latvia. On Nov. 18, 1918, just after the end of World War I, Latvia proclaimed itself independent. Russia and Germany tried to keep control of the new nation, but they finally recognized Latvia's independence in 1920.

In 1922, Latvia adopted a constitution that established a democratic form of government. The new democratic government passed land reform laws that broke up the large estates owned by a few wealthy people. The government divided this land into small farms and distributed the farms among the people. In 1936, during the Great Depression, Latvian democracy suffered a setback. The president seized power and reduced the role of parliament and the rights of the nation's political parties.

In 1939, shortly before World War II began, the Soviet Union and Germany agreed secretly to divide much of eastern Europe between themselves. The Soviet Union had been formed in 1922 under Russia's leadership. The Soviet Union forced Latvia to sign a treaty under which the Soviets built military bases in Latvia. Soviet troops occupied Latvia in June 1940, and Latvian Communists took over the government. In August, Latvia became part of the Soviet Union.

German forces invaded Latvia in 1941. They occupied Latvia until 1944, when Soviet troops recaptured it. Many Latvians who tried to prevent the Soviet Union from taking over their country were either killed or deported.

Life in Latvia changed greatly under the Soviets. The Soviet Union established a powerful Communist government and took control of all industry and land. The Communist Party became Latvia's only legal political party. In addition, a growing number of Russian immigrants reduced the influence of the Latvian culture and language. Continuing Russian immigration has threatened to make the Latvians a minority in their own land.

Through the years, Latvians expressed their national spirit and opposition to Soviet rule. Latvian nationalism became especially strong during the mid-1980's, when Soviet leader Mikhail Gorbachev began calling for greater openness of expression in the Soviet Union. In 1988, Latvian reformers established the Popular Front—also called the People's Front—a large non-Communist organization. In the late 1980's, the government of the republic agreed to restore the national Latvian flag and anthem—which had been banned—and allowed freedom to the press and to religious groups. It also changed the official language of the republic from Russian to Latvian.

In late 1989, Latvia ended the Communist Party's monopoly and began to establish a multiparty political system. Parliamentary elections were held early in 1990. On May 4, 1990, parliament declared the restoration of Latvian independence and called for a gradual separation from the Soviet Union. The Soviet government called the declaration illegal. In January 1991, commandos of the Soviet Interior Ministry raided the headquarters of the Latvian Interior Ministry, killing four people. In August 1991, several conservative Communist officials failed in an attempt to overthrow Gorbachev and take over the Soviet central government. During the upheaval that followed, the Latvian parliament declared independence. In September, the Soviet government recognized Latvia's independence. In December, the Soviet Union was dissolved.

In elections held in 1993, Russian nationals living in Latvia were not permitted to vote. The problem of civil rights and citizenship for Russian immigrants was an important issue in the election campaign. Twenty-seven per cent of the seats in parliament were won by radical nationalist parties. Parliament chose Guntis Ulmanis as president.

See also **Baltic States; Riga.**

Laudanum. See **Opium** (History).

Laughing gas. See **Nitrous oxide.**

Laughing jackass. See **Kookaburra.**

Laughton, Charles (1899-1962), was an English-born actor. He won fame both in England and the United States for his strong character roles.

Laughton made his stage debut in London in 1926 and his feature film debut in 1929. He acted in 52 films. Laughton achieved fame in the 1930's for a series of British films, notably *The Private Life of Henry VIII* (1933), for which he won the Academy Award for best actor, and *Rembrandt* (1936). His most celebrated performances came in the *Sign of the Cross* (1932), *The Barretts of Wimpole Street* (1934), *Ruggles of Red Gap* (1935), *Les Misérables* (1935), *Mutiny on the Bounty* (1935), *The Hunchback of Notre Dame* (1939), *The Suspect* (1945), *Hobson's Choice* (1954), *Witness for the Prosecution* (1958), *Spartacus* (1960), and *Advise and Consent* (1962). Laughton directed one film, the allegorical suspense drama *The Night of the Hunter* (1955).

Laughton was born in Scarborough, North Yorkshire. He became a U.S. citizen in 1950.

Launceston (pop. 66,286) is the second largest city in the Australian island state of Tasmania. It stands at the head of the Tamar River, about 65 kilometres from the northern coast, in a valley sheltered in the south by high mountains. By road, it is about 200 kilometres north of Hobart. Launceston has old-world buildings set among parks and gardens. But it is also a thriving industrial centre in one of the richest farming areas in Tasmania. It has woollen mills and railway workshops. It exports wool, apples, vegetables, minerals, and timber. An aluminium plant at Bell Bay, 48 kilometres north of the city, refines bauxite from Weipa, in Queensland. A hydroelectric power station at Trevallyn supplies electric power for the state grid.

Tourist attractions in the area include the Federal Country Club-Casino, the Penny Royal World, the Cataract Gorge, the Waverley Woollen Mills, and the Queen Victoria Museum and Art Gallery. Several fully restored, stately country homes, such as Entally House, Franklin House, and Clarendon, are open to the public.

Launching. See **Guided missile** (Launching equipment); **Rocket; Ship** (Launching and outfitting a ship); **Space exploration.**

Launfal, Sir, was a knight of King Arthur's Round Table in medieval British legend. He was the hero of several literary works. The earliest-known one, *Lai de Lanval,* was written in the late 1100's by the French poet Marie de France. In this story, Launfal falls in love with a beautiful fairy. She gives him wealth and happiness but makes him promise not to reveal their source.

The American poet James Russell Lowell wrote the best-known modern story of Launfal, *The Vision of Sir Launfal* (1848). In this tale, Launfal dreams of searching for the Holy Grail, the cup that Jesus Christ used at the Last Supper. Launfal does not find the Grail, but he learns its meaning when he helps a starving leper, who teaches him that the Grail symbolizes charity and mercy.

Laura Ingalls Wilder Award is an American literary award. The award is presented to any author or illustrator published in the United States who has made "a lasting and substantial contribution" to children's literature. The Association for Library Service to Children, a division of the American Library Association, selects the winner. The award was established in 1954 to honour Laura Ingalls Wilder, an American author best known for her "Little House" series. The award, a bronze medal, depicts Wilder as a child holding a doll. The award was given every five years from 1960 to 1980. Since 1980, it has been given every three years.

Laureate. See **Poet laureate.**

Laurel is the name of several types of trees and shrubs with spear-shaped evergreen leaves. The original laurel or *true laurel* is also called *bay* or *sweet bay* and originates in the Mediterranean region. Its dried leaves are used in cooking. See **Bay tree.**

Spotted laurels are native to Eastern Asia. They are planted in city areas because their large, glossy leaves are tolerant of pollution.

Cherry laurels have pointed evergreen leaves mid-green above and pale green below. They have white, upright flower spikes. They are excellent for hedging.

Scientific classification. The true laurel belongs to the laurel family, Lauraceae. It is *Laurus nobilis.* Spotted laurels belong to the dogwood family, Cornaceae. Cherry laurels belong to the rose family, Rosaceae.

See also **Avocado; Camphor; Cinnamon.**

Laurel

Laurel, Jose Paciano (1891-1959), a lawyer and politician, served as president of the Philippines in the government set up by the Japanese in 1943. At the end of World War II, when the Americans returned to the Philippines in 1945, he fled to Tokyo. He was jailed at Sugamo prison for two years. In 1949, he ran for the presidency of the Philippines against Elpidio Quirino. He lost narrowly amid charges of collaboration with the Japanese. In 1951, he was elected to the Senate.

Laurel was born in Tanawan, in Bantangas province of the Philippines. He studied law at the University of the Philippines and took his doctorate degree at Yale University in the United States in 1920. He served as a Senator from 1925 to 1931. He was secretary of justice when war broke out in 1941.

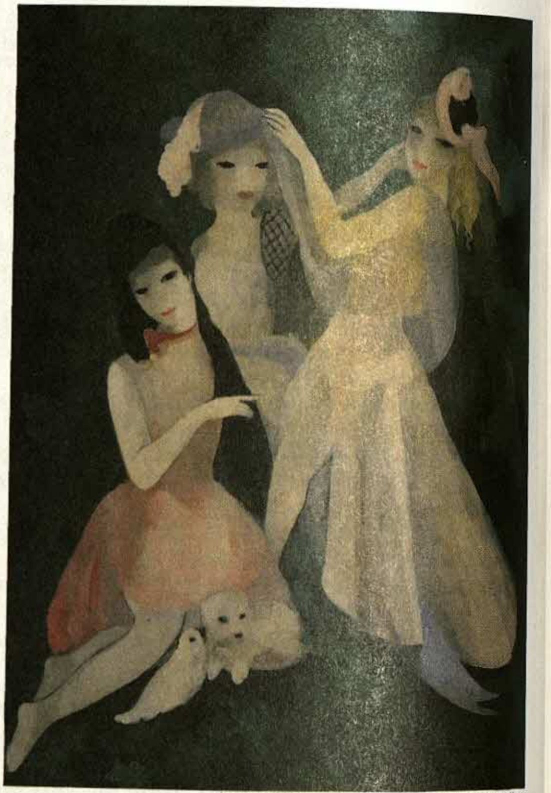
Laurel and Hardy were the most popular comedy team in American cinema history. Stan Laurel (1890-1965) played a timid little dimwit. He continually exasperated his partner, Oliver (Ollie) Hardy (1892-1957), who played a fat, bullying know-it-all. The team starred in more than 60 short films and 27 feature films from 1926 to 1952. Unlike most stars of the silent film era, Laurel and Hardy also made successful sound films. One of them, *The Music Box* (1932), won an Academy Award as best comedy short subject.

Laurel, whose real name was Arthur Stanley Jefferson, was born in Ulverston, England, and began his career in music hall. He moved to the United States in 1910 and made his first film in 1917. Oliver Norvell Hardy was born in Harlem, Georgia, U.S.A. He made his first short comedies in 1913 and moved to Hollywood in 1918. Laurel and Hardy first teamed up in 1926 in *Putting Pants on Philip,* which was released in 1927. Their later films included *Babes in Toyland* (1934), *Sons of the Desert* (1934), *Way Out West* (1937), and *Blockheads* (1938).

Laurence, Margaret (1926-1987), was a Canadian novelist, short-story writer, and essayist. She is best known for her vivid and sympathetic portraits of woment in her fiction. Such portraits appear in her five novels set in the fictional prairie town of Manawaka. The novels are *The Stone Angel* (1964), *A Jest of God* (1966), *The Fire-Dwellers* (1969), *A Bird in the House* (1970) and *The Diviners* (1974). Laurence was born Jean Margaret Wemyss in Neepawa, Manitoba.

Scene from *Helpmates* (1931)

Laurel and Hardy formed a famous film comedy team. Hardy, *left,* played a blustery character. Laurel was his foolish partner.



In the Park (1924), an oil painting on canvas; National Gallery of Art, Washington, D.C.

A Laurencin painting portrays a group of young women in casual poses. The pale colours are typical of the artist's style.

Laurencin, Marie (1885-1956), was a French painter and designer. Her best-known paintings portray young upper-class women, often during moments of leisure. In the 1920's, Laurencin created a slender, long-waisted female type that contributed to the *flapper* fashions of that period. Laurencin painted in a decorative style she easily adapted to commercial art. She became a successful designer of book illustrations, stage sets, wallpaper, textiles, and women's clothing.

Laurencin was born in Paris. In the early 1900's, she became part of a circle of modern artists that included Pablo Picasso and Henri Matisse. Laurencin was an illegitimate child and never learned her father's identity. Some scholars believe her paintings of single figures of women and women in small groups indicate a sense of isolation and an antimale attitude.

Laurentian Plateau. See **Canadian Shield.**

Lausanne (pop. 125,004; met. area pop. 258,071) is a city in western Switzerland, on the north shore of Lake Geneva. For the location of Lausanne, see **Switzerland** (map). Lausanne is a major centre of tourism and the commercial and industrial centre of its region. The city also serves as the capital of the *canton* (state) of Vaud. It is the home of the Federal Tribunal, Switzerland's highest court.

Lausanne is a hilly city with steep roads. Huge bridges connect some of the hills. Lausanne's landmarks include a medieval castle and a medieval Gothic cathedral with beautiful stained glass windows. Its many industries in-

Lausanne, Switzerland, is a famous tourist centre. The city is built on hills nestled along the northern shore of beautiful Lake Geneva.

clude printing, woodworking, and the manufacture of chemicals, metal products, and radios.

Roman soldiers established a colony on the site of what is now Lausanne in about 50 B.C. The Swiss city of Bern conquered Lausanne and the rest of Vaud in 1536. Vaud gained independence in the late 1700's. In 1803, it joined the union of Swiss cantons called the Swiss Confederation.

Lausanne, Treaty of. See **Greece** (World War I).

Laussedat, Aimé. See **Photogrammetry.**

Lava is molten rock that pours out of volcanoes or from cracks in the earth. It comes from deep in the earth where the heat is great. There, it is called *magma.* When lava first comes to the surface it is red hot, reaching temperatures from 7 to 12 times hotter than boiling water.

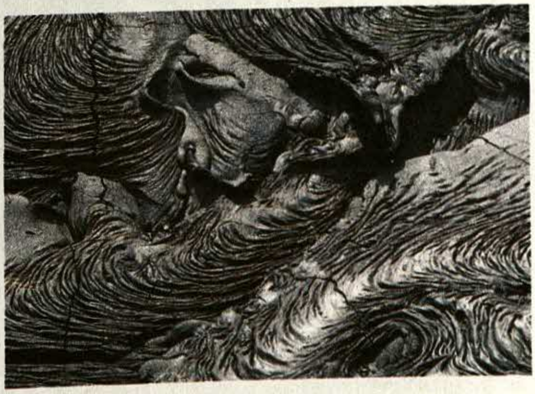
Properties of lava. Lava is a solution of silicate minerals (see **Silica**). It is similar to the hot liquid that would result if granite or basalt were melted. When lava cools rapidly, only a few crystals can form. The lava hardens into a rock that contains large amounts of natural glass.

The volcanoes or earth *fissures* (cracks) that contain the lava are sometimes explosive. From time to time they blow out large quantities of dust and rock fragments that form layers between lava flows. Some types of lava contain large amounts of dissolved gases. As the gases expand, they are trapped in the lava, and form many bubbles. *Pumice* is a type of lava that contains many bubbles (see **Pumice**).

Lands that were once covered with lava often become quite fertile after weathering has broken the lava into fine soil. Some lavas, such as a glassy lava called *perlite,* are heated in furnaces. They expand into a frothy material used to manufacture lightweight concrete.

Kinds of lava. There are two kinds of lava. One kind, called *aa,* is *viscous* (sticky) and moves slowly. The other kind, called *pahoehoe,* is so fluid that when it first erupts it flows down the side of a volcano faster than a

Red-hot, fiery lava may reach temperatures from 7 to 12 times as hot as boiling water. The photograph above shows lava flowing from Nyiragongo, a volcano in eastern Zaire.



Cooling lava hardens into various formations. Highly fluid lava forms smooth, folded sheets of rock, such as those found in the Galapagos Islands, *above.* Stickier lava produces jagged sheets.

Spongelike rock forms from lava with a high gas content. As such lava cools, it traps the gases and creates bubbles.

Glassy rock results from lava that cools and hardens so quickly that only a few crystals can form.

person can run. Both kinds cool at the surface first, forming a solid crust over a liquid core.

Sometimes the liquid lava inside the crust cracks the hardened lava surface into many rough blocks that drag and tumble along as the lava creeps down the side of the volcano. At other times, the lava breaks a hole through the rocky crust and flows through, leaving a huge lava cave or tunnel. The surface of such lava is covered with many wrinkles.

Location of lava beds. Many regions of the earth consist of piled-up sheets of lava. The islands of Hawaii are a chain of volcanoes built mostly of lava. The mountain belt of southern Mexico, with its hundreds of volcanoes, also has a great lava pile.

See also **Igneous rock; Rock** (Igneous); **Volcano.**

Laval, Pierre (1883-1945), was a French politician who collaborated with the Germans during World War II (1939-1945). After the Germans invaded France in May 1940, Laval urged surrender. He held office in the Vichy government and succeeded Henri Pétain as premier of Vichy France in April 1942 (see **Pétain, Henri Philippe; Vichy**). After Germany surrendered in 1945, Laval was handed over to the new French government and was convicted of treason. He swallowed poison in a suicide attempt on the day of his execution, but was revived and shot by a firing squad.

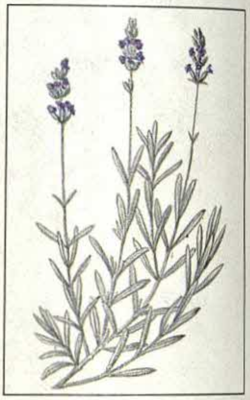
Laval was born in Auvergne province in southern France. He studied at the universities of Lyon and Paris. In 1914 he was elected to the French Chamber of Deputies, and after World War I began to rise in politics. He held several cabinet posts and was premier twice. In 1935, as premier, he shared in the Hoare-Laval Agreement, proposing that France and Britain negotiate peace between Italy and Ethiopia. In 1938 he supported the Munich Agreement, giving Germany part of Czechoslovakia.

Pierre Laval

Lavender is the name of about 20 species of small bushes that bear fragrant flowers and leaves. Lavender belongs to the mint family. It grows wild in Mediterranean countries and is widely cultivated.

Lavender bushes grow from 90 to 120 centimetres high. They have long, narrow, pale-green leaves and pale-purple flowers. This shade of purple is called *lavender* after the flowers. The flowers grow in clusters around the stem. When dried, they keep their fragrance for a long time.

Lavender comes from a Latin word that means *to wash.* This name may have been used because the ancient Romans used the leaves and flowers of the plant to scent their bathwater. Women once routinely stored dried lavender flowers with their linens and clothing. Today, the dried flowers are used in fragrant *sachets* (powders) and *potpourris* (mixtures). The flowers also are distilled to make an oil that is used in some perfumes.



Lavender

Scientific classification. Lavender bushes belong to the mint family, Labiatae (Lamiaceae), and make up the genus *Lavandula.*

See also **Mint; Perfume.**

Laver, Rod (1938-), is one of the leading tennis players of all time. He was born the year that Don Budge became the first man to win the Australian, British, French, and United States championships. In 1962, Laver became the only man to equal Budge's feat. In 1969, Laver again won the grand slam of tennis. He was the first player to do so twice.

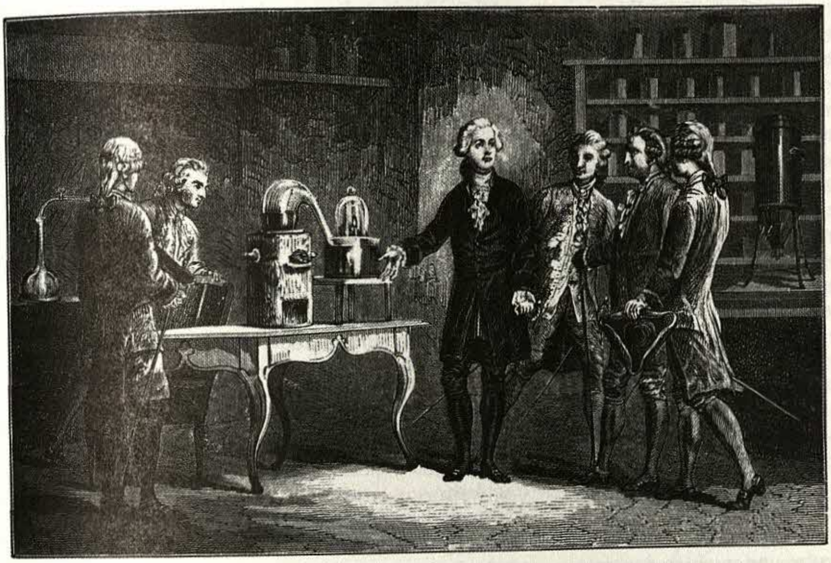
Rodney George Laver was born in Rockhampton, Australia, and played in four winning Australian Davis Cup teams. He lost two Davis Cup matches in 1959 but won all six of his singles events in the 1960, 1961, and 1962 Davis Cup finals. Laver became a professional player in 1963.

Laveran, Charles Louis Alphonse (1845-1922), a French Army surgeon, discovered the parasite that causes malaria. He also made other contributions to the knowledge of tropical diseases. He received the 1907 Nobel Prize for medicine.

In Algeria, in 1880, Laveran recognized the malaria parasite in the blood of soldiers suffering from the disease. As early as 1884, he became convinced that mosquitoes played an important part in spreading the disease. In 1892, he described several species of *trypanosomes,* the parasites that cause sleeping sickness.

Laveran was born in Paris and served as a military surgeon for 29 years. He retired from the army in 1907 and became director of the Honorary Service of the Pasteur Institute in Paris.

La Vérendrye, Sieur de (1685-1749), Pierre Gaultier de Varennes, was a French-Canadian fur trader and explorer. In 1731, La Vérendrye, three of his sons, and a nephew set out from Montreal, Canada, to find an overland route to the Pacific Ocean. They got as far west as what are now Saskatchewan in Canada and the Dakotas



Antoine Laurent Lavoisier, French chemist of the 1700's, demonstrates his experiment to determine the composition of air. Lavoisier is regarded as the founder of modern chemistry.

in the United States by 1738. Two of the sons may have reached the Rocky Mountains in 1742. Along the way, La Vérendrye established outposts that served as forts and fur-trading stations, and he claimed much land for the French king. He returned to Montreal in 1743.

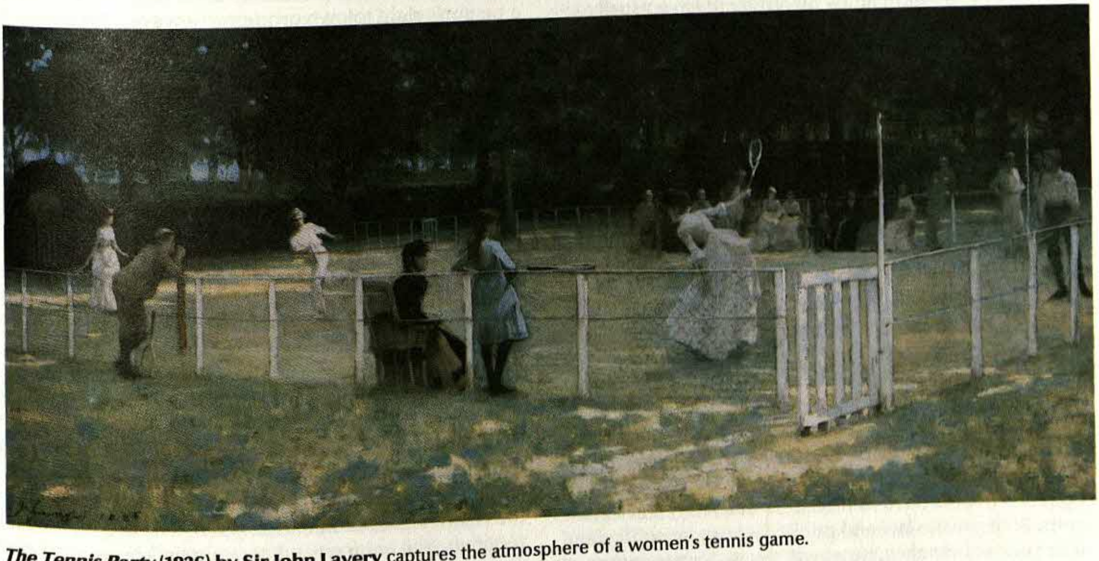
La Vérendrye was born in Trois-Rivières, Quebec. He served in the French Army in Canada and France before he began exploring.

Lavery, Sir John (1856-1941), an Irish painter, became well known for his portraits of women. His most famous portraits include *Miss Mary Burrell* and *Mrs. Lavery Sketching.* Lavery was born in Belfast. He was apprenticed to a painter-photographer in Glasgow. Later, he studied art in Glasgow, London, and Paris.

Lavin, Mary (1912-   ), is an American-born writer of novels and short stories set in an Irish background. Her book of short stories *Tales From Bective Bridge* won the James Tait Black Memorial Prize in 1943. Her other books of short stories include *The Long Ago* (1944) and *A Single Lady* (1951). *The House in Clewe Street* (1945) and *Mary O'Grady* (1950) are novels. Mary Lavin was born at East Walpole, Massachusetts, U.S.A. She moved to Ireland when she was 10, and studied at the National University of Ireland.

Lavoisier, Antoine Laurent (1743-1794), a French chemist, was the founder of modern chemistry.

Lavoisier carefully measured the weights of substances involved in chemical reactions. In 1772, he began a series of experiments that demonstrated the nature of *combustion* (burning). He concluded that combustion results from the union of a flammable material with a newly discovered gas, which he called oxygen. Lavoisier published his findings in his *Elementary Treatise on Chemistry* (1789).



***The Tennis Party* (1926) by Sir John Lavery** captures the atmosphere of a women's tennis game. Lavery's paintings often featured women.

With French astronomer and mathematician Pierre Simon Laplace, Lavoisier conducted experiments on respiration in animals. Their studies demonstrated a similarity between common chemical reactions and the processes that occur in living organisms. These experiments provided the foundation for the science now known as biochemistry. Lavoisier also helped develop a system for naming chemical substances based on their composition. This system is still in use.

Lavoisier was born in Paris. He received an excellent education and developed an interest in all branches of science, especially chemistry. He was elected to the French Academy of Sciences in 1768.

Lavoisier was arrested in 1793 by the leaders of the French Revolution. Many years earlier, he had become a partner in a firm that collected a number of taxes for the government. In spite of his achievements, Lavoisier was found guilty of conspiracy with the enemies of France because of his involvement in tax collection. He was executed by guillotine.

See also **Oxygen; Chemistry** (Lavoisier's contributions; picture).

Law is the set of enforced rules under which a society is governed. Law is one of the most basic social institutions—and one of the most necessary. No society could exist if all people did just as they pleased, without regard for the rights of others. Nor could a society exist if its members did not recognize that they also have certain obligations toward one another. The law thus establishes the rules that define a person's rights and obligations. The law also sets penalties for people who violate these rules, and it states how government shall enforce the rules and penalties. However, the laws enforced by government can be changed. In fact, laws frequently are changed to reflect changes in a society's needs and attitudes.

In most societies, various government bodies, especially police agencies and courts, see that the laws are obeyed. Because a person can be penalized for disobeying the law, most people agree that laws should be just. Justice is a moral standard that applies to all human conduct. The laws enforced by government have usually had a strong moral element, and so justice has generally been one of the law's guiding principles. But governments can, and sometimes do, enforce laws that many people believe to be unjust. If this belief becomes widespread, people may lose respect for the law and may even disobey it. But in democratic societies, the law itself provides ways to amend or abolish unjust laws.

This article discusses the main branches of law, the world's major legal systems, and the methods that democracies use to change laws. Many separate *World Book* articles provide detailed information on topics related to law. For a list of these articles, see the *Related articles* at the end of this article.

Branches of law

Law can be divided into two main branches: (1) private law and (2) public law. Private law deals with the rights and obligations people have in their relations with one another. Public law concerns the rights and obligations people have as members of society and as citizens. Both private law and public law can be subdivided into several branches. However, the various branches of public and private law are closely related, and in many cases they overlap.

Private law determines a person's legal rights and obligations in many kinds of activities that involve other people. Such activities include everything from borrowing or lending money to buying a home or signing a job contract.

The great majority of lawyers and judges spend most of their time dealing with private law matters. Lawyers handle most of these matters out of court. But numerous situations arise in which a judge or jury must decide if a person's private-law rights have been violated.

Private law can be divided into six major branches according to the kinds of legal rights and obligations involved. These branches are (1) contract and commercial law, (2) tort, (3) property law, (4) inheritance law, (5) family law, and (6) company law. The dividing line between the various branches is not always clear, however. For example, many cases of property law also involve contract law.

Contract and commercial law deals with the rights and obligations of people who make contracts. A contract is an agreement between two or more persons that can be enforced by law. A wide variety of business activities depend on the use of contracts. A business firm makes contracts both with other firms, such as suppliers and transporters, and with private persons, such as customers and employees.

Tort. A tort is a wrong or injury that a person suffers because of someone else's action. The action may cause bodily harm; damage a person's property, business, or reputation; or make unauthorized use of a person's property. The victim may sue the person or persons responsible. The law of tort deals with the rights and obligations of the persons involved in such cases. Many torts are unintentional, such as causing damage in traffic accidents. But if a tort is deliberate and involves serious harm, it may be treated as a crime.

Property law governs the ownership and use of property. Property may be *real,* such as land and buildings, or *personal,* such as a car and clothing. The law ensures a person's right to own property. However, the owner must use the property lawfully. People also have the right to sell or lease their property and to buy or rent the property of others. Property law determines the rights and obligations involved in such dealings.

Inheritance law, or *succession law,* concerns the transfer of property upon the death of the owner. Nearly every country has basic inheritance laws, which list the relatives or other persons who have first rights of inheritance. But in most Western nations, people may *will* their property to persons other than those specified by law. In such cases, inheritance law also sets the rules for the making of wills.

Family law determines the legal rights and obligations of husbands and wives and of parents and children. It covers such matters as marriage, divorce, adoption, and child support.

Company law governs the formation and operation of business corporations or companies. It deals mainly with the powers and obligations of management and the rights of shareholders. Company law is often classed together with contract and commercial law as *business law.*

Public law involves government directly. It defines a person's rights and obligations in relation to government. Public law also describes the various divisions of government and their powers.

Public law can be divided into four branches: (1) criminal law, (2) constitutional law, (3) administrative law, and (4) international law. In many cases, the branches of public law, like those of private law, overlap. For example, a violation of administrative law may also be a violation of criminal law.

Criminal law deals with crimes—that is, actions considered harmful to society. Crimes range in seriousness from disorderly conduct to murder. Criminal law defines these offences and sets the rules for the arrest, the possible trial, and the punishment of offenders. Law that is not criminal law is defined as *civil law,* although this also has another meaning, discussed later. Some crimes are also torts and the victim may sue for damages under civil law.

In the majority of countries, the central government makes most of the criminal laws. In some countries, such as Australia and the United States, each state, as well as the federal government, has its own set of criminal laws. However, the criminal laws of each state must protect the rights and freedoms guaranteed by federal constitutional law.

Constitutional law. A constitution is a set of rules and principles that define the powers of a government and the rights of the people. The principles outlined in a constitution form the basis of constitutional law. The law also includes official rulings on how a constitution's principles are to be interpreted and carried out.

Most nations have a written constitution. A major exception is Great Britain. The British constitution is unwritten. It consists of all the documents and traditions that have contributed to Britain's form of government. In most democracies, the national constitution takes first place over all other laws.

Conflicts between a constitution and other laws are settled by constitutional law. In many countries, the courts have the power of *judicial review,* under which they may overturn any laws judged to be *unconstitutional.*

Administrative law centres on the operations of government departments. Administrative law is one of the most complicated branches of law.

Governments set up many *administrative departments* to do the work of government. They deal with such matters as education, public health, and taxation. Other departments administer social welfare provisions, such as pensions and social security. In most cases, the departments are established in the executive branch of government under powers granted by the legislature. Administrative law consists chiefly of (1) the legal powers granted to administrative departments by the legislature and (2) the rules that the departments make to carry out their powers. Administrative law also includes court rulings in cases between the departments and private citizens.

International law deals with the relationships among nations both in war and in peace. It concerns trade, communications, boundary disputes, methods of warfare, the uses of the ocean, and many other matters. Laws to regulate international relations have been developed over the centuries by customs and treaties. But international law, unlike other branches of law, is difficult to enforce.

Systems of law

Every independent country has its own legal system. The systems vary according to each country's social traditions and form of government. But most systems can be classed as either (1) a common-law system or (2) a civil-law system. Australia, Ireland, New Zealand, Great Britain (except Scotland), the United States, and other English-speaking countries have a common-law system. Most other countries have a civil-law system. Many countries combine features of both systems.

Common-law systems are based largely on *case law* —that is, on court decisions. The common-law system began in England many hundreds of years ago. The English called their system *the common law* because it applied throughout the land.

English common law developed from the rules and principles that judges traditionally followed in deciding court cases. Judges based their decisions on legal *precedents*—that is, on earlier court rulings in similar cases. But judges could expand precedents to make them suit particular cases. They could also *overrule* (reject) any precedents that they considered to be in error or outdated. In this way, judges changed many laws over the years. The common law thus came to be law made by judges.

However, some common-law principles proved too precious to change. For example, a long line of hard-won precedents defended the rights and liberties of citizens against the unjust use of government power. England—and the other common-law countries—have kept these principles almost unchanged. Australia, Canada, New Zealand, the United States, and other countries that were colonized by England based their legal systems on the common law.

Case law is still important in common-law countries. However, the lawmaking role of legislatures in these countries has increased greatly during the 1900's. The changes have dealt with such matters as employee management relations, workers' wages and hours, and environmental protection. Nevertheless, common-law countries have kept the basic feature of the English legal system, which is the power of judges to make laws. In addition, constitutional law in these countries continues the common-law tradition of defending the people's rights and liberties.

Civil-law systems are based mainly on *statutes* (legislative acts). The majority of civil-law countries have assembled their statutes into one or more carefully organized collections called *codes.* Most modern law codes can be traced back to the famous code commissioned by the Roman emperor Justinian I in the A.D. 500's. Justinian's code updated and summarized the whole of Roman law. It was called the *Corpus Juris Civilis,* meaning *Body of Civil Law.* For this reason, legal systems that are based on the Roman system of statute and code law are known as *civil-law* systems. This use of the term *civil law* should not be confused with its use as an alternative term for *criminal law.*

In civil-law countries, such as France, Germany, and Mexico, the statutes, not the courts, provide the final answer to any question of law. Judges may refer to precedents in making their decisions. But they must base every decision on a particular statute and not on precedent alone.

Other systems. Many countries have patterned their legal system after both civil law and common law. For example, Japan and most Latin-American nations have assembled all their private law into a code. But public law in these countries has been greatly influenced by common-law principles, especially those that guarantee the rights and liberties of the people.

In China, where a billion people still live under Communist rule, the Ministry of Justice and the court system administer public, economic, and criminal laws. A procedure exists for handling private law cases, but no private law has been adopted by the state. Laws must conform to the Communist policies of China's leaders.

How laws are changed

Social conditions are continually changing, and so the law must also change or it will become outdated. Every nation changes its laws in the manner that its political system prescribes. In a dictatorship, only the top government leaders are able to change the law. Democracies, however, have developed four main methods of changing the law: (1) by court decision, (2) by legislation, (3) by administrative action, and (4) by direct action of the people.

By court decision. Judges in common-law countries change laws by expanding or overruling precedents. However, a precedent can normally be overruled only by a higher court. If a government does not like the way a court has interpreted the law, it must change the law by legislation.

By legislation. Legislatures may change laws as well as make them. A legislature can change a statute by amending it; by *repealing* (cancelling) it; or by passing a new law on the same subject. In most countries with a written constitution, some form of legislative action is required to amend the constitution.

By administrative action. Government departments may be authorized to make, amend, repeal, or replace regulations. This is known as *delegated legislation.* They may also be authorized to interpret an old regulation to meet changing conditions.

By direct action of the people. Some national and many local governments give the people direct power to change the law by *referendum* and by *initiative.* In a referendum, a law or a proposed law is submitted to the voters for their approval or rejection. In an initiative, a group of citizens proposes a law, which is then approved or rejected by the legislature or by referendum. Many countries have repealed their constitution one or more times and replaced it with a new one. In most such cases, the new constitution cannot take effect until it has been approved by referendum.

The development of law

Civilized societies are so complex that they could not exist without a well-developed system of law. Scholars therefore conclude that people began to formulate laws in prehistoric times, before the first civilizations arose. Prehistoric people had no system of writing, and so they left no record of their laws. The earliest laws were *customary* laws—that is, laws that became established by custom and were handed down orally from one generation to the next.

The first civilizations and first systems of writing ap-

The branches of law This table lists the major branches of private and public law and some of the legal matters they cover. A matter governed by one branch may also involve one or more other branches. For example, many cases of property law also concern contract law.

Private law

Contract and commercial law
- Credit purchases
- Employment contracts
- Guarantees
- Insurance policies
- Patents
- Promissory notes
- Sales contracts
- Subscriptions

Tort
- Negligence
- Nuisance
- Personal injury
- Product liability
- Professional malpractice
- Slander and libel
- Traffic accidents
- Trespass

Property law
- Landlord and tenant relations
- Mortgages
- Transfers of ownership
- Unclaimed property

Inheritance law
- Estates
- Probate
- Trusts
- Wills

Family law
- Adoption
- Annulment
- Custody of children
- Divorce
- Marriage

Company law
- Company finance
- Articles of association
- Mergers and acquisitions

Public law

Criminal law
- Arson
- Bribery
- Burglary
- Extortion
- Forgery
- Kidnapping
- Manslaughter
- Murder
- Perjury
- Rape
- Robbery
- Theft

Constitutional law
- Civil rights
- Government powers
- Separation of executive, judicial, and legislative powers

Administrative law
- Consumer protection
- Environmental protection
- Public safety
- Social welfare
- Taxation
- Workers' wages and hours

International law
- Arms control
- Extradition
- Hijacking and piracy
- Human rights
- Territorial waters
- Uses of outer space
- Uses of the ocean
- War crimes

peared between about 3500 and 3000 B.C. The invention of writing enabled people to assemble law codes. The development of written codes made the law a matter of public knowledge and so helped advance the rule of law in society. The first law codes were produced by ancient civilizations in the Middle East.

Early developments in the East. The first known law codes appeared in the ancient Middle Eastern land of Babylonia. A Babylonian king named Ur-Nammu assembled the earliest known code about 2100 B.C. Other Babylonian rulers produced codes during the following centuries. A king named Hammurabi drew up the most complete and best known of these codes during the 1700's B.C. Hammurabi's code, like the earlier ones, consisted mainly of a long list of rules to settle specific types of cases. The code laid down the law for such matters as the unfaithfulness of a wife, the theft of a farm animal, and the faulty work of a housebuilder. Many of the punishments were harsh by today's standards. For example, a son found guilty of striking his father had his hand cut off.

From about 1000 to 400 B.C., the Hebrew people of the Middle East assembled their religious and social laws into a code. The code reflected the teachings of Moses, a great Hebrew leader of the 1200's B.C., and so it is often called the *Mosaic Code* or the *Law of Moses.* The Mosaic Code stressed moral principles. It became a key part of the first books of the Hebrew Bible and later of the Christian Bible. According to the Bible, the part of the code known as the *Ten Commandments* was given to Moses by God. The commandments therefore have had enormous influence on the moral content of the law in Western civilization.

By about 500 B.C., the civilizations of India and China had also produced codes of law. The codes in both countries stressed the moral obligations of the law. However, except for the religious laws of the Hebrew people, the legal traditions of Eastern civilizations have had little direct influence on today's major systems of law. Many Eastern peoples, even those influenced by Western traditions, still stress the moral obligations of the law. Accused persons have little opportunity to defend themselves. Concern for the rights of an accused person—and for the rights of all citizens—developed mainly in Western civilization. But this development occurred slowly over many hundreds of years. Most scholars regard the ancient Greeks as the founders of both Western law and Western civilization.

The influence of ancient Greece. Unlike earlier civilizations, the civilization of ancient Greece made the law a clearly human institution. Before the Greeks, most people believed that only gods and goddesses had the power to make laws. The gods and goddesses gave the laws to certain chosen leaders. These leaders passed them on to the people. Like earlier peoples, the ancient Greeks believed that gods and goddesses required human beings to obey the law. But the Greeks also believed that human beings have the power to make laws—and to change them as the need arises. The Greek city-state of Athens became the chief centre of this development.

A politician named Draco drew up Athens' first law code in 621 B.C. It became famous mainly for its harsh penalties for lawbreakers. In the 590's B.C., the ruling council of Athens authorized a high-ranking official named Solon to reform the city's legal and political system. Solon repealed most of Draco's stern laws and drew up a much fairer code in their place. Solon also made the Athenian assembly more representative and increased its lawmaking powers. In time, elected assemblies of citizens gained more and more legislative power in Athens. The Greeks thus began another key development of Western civilization—the founding of democratic government. However, as many as a third of the people of Athens were slaves. The Athenians, like other ancient peoples, denied slaves the legal rights of citizens.

The Greeks believed strongly in the importance of law. They considered respect for the law to be the mark of the good citizen. The great Athenian philosopher and teacher Socrates became the supreme example of this belief. The court sentenced Socrates to death in 399 B.C. for teaching Athenian youths to disrespect the law. Socrates knew that he was innocent. But he accepted his sentence to show his respect for the law.

Ancient Roman law. Ancient law reached its peak under the Romans. Roman law included all the main branches of public and private law that exist today. In fact, the scientific classification of the law began with the Romans. The Romans designed their laws not only to govern the people of Rome but also to build and hold together a vast empire. By the early A.D. 100's, the Roman Empire included much of Europe and the Middle East and most of northern Africa.

Early Roman times. The first known Roman law code, called the Laws of the Twelve Tables, was written about 450 B.C. It set down the chief customary laws of the Roman people in a form that was easy to remember. For hundreds of years, Roman boys had to memorize the code as part of their schoolwork.

The principles expressed in the Twelve Tables long remained the basis of Roman law. But the Romans gradually amended these principles to meet changing social conditions. After 367 B.C., a high public official called a *praetor* made the chief amendments. Each year, the praetor issued an *edict* (public order) that made any necessary changes. After 27 B.C., the Roman emperor could make or change laws as he wished. Eventually, the whole body of Roman law became extremely complex. The task of interpreting this great mass of laws fell to a group of highly skilled lawyers called *juris prudentes,* a Latin term for *experts in law.* Since that time, the science of law has been known as *jurisprudence.*

For many years, Romans and non-Romans within the empire were governed under different sets of laws. Roman citizens were governed under the *jus civile* (civil law). The Romans developed a special set of laws, called the *jus gentium* (law of the nations), to rule the peoples they conquered. They based these laws on principles of justice that they believed applied to all people. Such principles are known as *natural law.*

However, neither the jus civile nor the jus gentium granted any legal rights to slaves. Under Roman law, only Roman citizens could own property, make contracts and wills, and sue for damages. Slaves were not citizens, and so they had none of these rights. As the Romans developed the idea of natural law, however, they recognized that slaves had human rights that should be respected. Roman law thus began to require that slaves be treated fairly and decently.

Late Roman times. The belief in natural law also led to the idea that non-Romans within the empire should have the same rights as citizens. In A.D. 212, the Romans granted Roman citizenship to most of the peoples they had conquered, except slaves. The jus civile then became the law of the entire empire.

However, the principles of natural law set down in the jus gentium remained part of Roman law. These principles were important to future generations because they led to the belief in equal rights for all citizens. But hundreds of years passed before people fully developed the principles of equality that were outlined by the Romans. Once the principles had been developed, they contributed to the building of democratic governments in Australia, France, New Zealand, the United Kingdom, the United States, and many other countries.

Beginning with Julius Caesar, a long line of Roman rulers had tried to organize all the empire's laws into an orderly code. Emperor Justinian I finally completed this task. Justinian's code, the famous *Corpus Juris Civilis* (Body of Civil Law), went into effect in 533 and 534. It covered the whole field of law so completely and so skilfully that it later became the model for the first modern law codes. Even today, the codes of most civil-law countries are based on Roman law.

The Middle Ages. In 395, the Roman Empire split into two parts—the West Roman Empire and the East Roman, or Byzantine, Empire. The West Roman Empire, which had its capital in Rome, fell to invading Germanic tribes in the late 400's. The empire's fall marked the start of the 1,000-year period known as the Middle Ages. The East Roman Empire, which had its capital in Constantinople (now Instanbul), escaped the invasions. In 527, Justinian I became the ruler of the eastern empire, and his great code of Roman law was mainly enforced there. In Western Europe, most of the legal and cultural institutions developed by the Romans gradually died out.

However, Roman law survived in the West as the basis for *canon law*—the legal system developed by the Roman Catholic Church. Most Europeans during the Middle Ages were Catholics, and so canon law had a powerful influence on their lives.

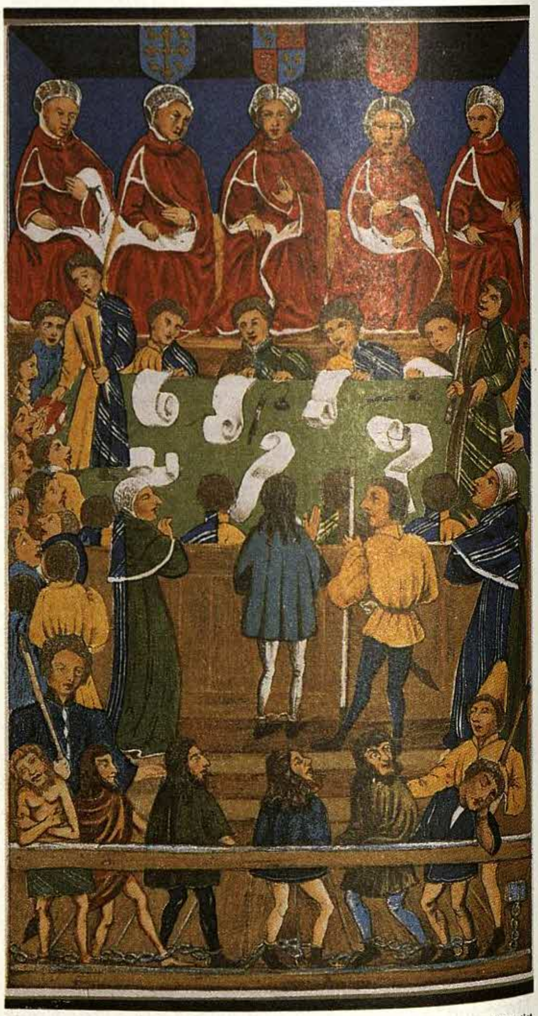
The Germanic tribes that overthrew the West Roman Empire had their own law codes, which they introduced into the regions they conquered. But these codes were undeveloped compared with Roman law. They consisted chiefly of long lists of fines for specific offences, such as stealing a neighbour's ox or dog.

By the 800's, Europeans had developed a political and military system known as *feudalism.* Under feudalism, people owed allegiance to individual lords rather than to a central government. A lord enforced the law in his territory and granted protection to the people who served in his armies and who lived and worked on his land. The legal system of the Middle Ages was largely based on this relationship between lords and the people who depended on them.

In particular, feudal law spelled out the duties that people owed to their lord. But a lord could not demand more than the law allowed. The people thus had a right to refuse any demands by their lord that went beyond the limits of the law. Europeans later used this principle to resist monarchs who claimed too much power. The principle thus played an important role in the struggle for democracy in Europe.

Feudal law remained the basic law in western Europe until about 1300. By then, western Europeans had begun to establish improved legal systems. However, this development differed greatly between the countries of mainland Europe and the British Isles.

Developments in mainland Europe. The economy of western Europe began to grow rapidly during the 1000's. As commerce and industry increased, they created a need for a set of laws that was more complex and varied than feudal law. Scholars believed that ancient Roman law could meet this need. Beginning about 1100, the University of Bologna in northern Italy trained law students from many parts of Europe in the principles of the Corpus Juris Civilis. Interest in the code soon spread



Illuminated manuscript (about 1450) by an unknown English artist

The King's Bench was England's chief criminal court during the late Middle Ages. It helped establish the nation's *common law*—that is, a uniform body of law that applied throughout England. In this picture, chained prisoners, *bottom,* await their turn to be tried before judges, *top.*

to other European universities. Roman law thus gradually began to replace feudal law throughout mainland Europe.

Developments in Britain. England already had a strong, unified legal system by the 1200's, when Roman law was beginning to spread across Europe.

England's legal system had grown out of the country's courts. English courts had long based their decisions on the customs of the English people. But customs varied from district to district. As a result, similar cases were often judged differently in different districts. In the early 1100's, however, strong English kings began to set up a nationwide system of royal courts. In this way, the courts soon established a body of *common law*—that is, law which applied equally anywhere in England. Judges could change the law but any change applied in all common-law courts.

As English common law developed, it established many precedents that limited the powers of government and protected the rights of the people. These precedents made all the people, including the monarch, subject to the law.

Alongside the common law, there also developed in England a separate system of justice, known as *Equity.* In the Middle Ages, people who could not obtain a remedy at common law turned to the lord chancellor for assistance. The lord chancellor, and later his assistants in the Court of Chancery, based their decisions on the principles of *equity* (moral justice). In time, these principles became fixed rules. The rules of equity are still separate from the rules of common law. See **Equity.**

The English legal system is the basis of United Kingdom law, except for Scotland. Scottish law is based on a combination of Roman law and feudal custom. When Ireland became a republic it continued to use a system similar to the English system. See **United Kingdom, Legal systems of the.**

The first modern law codes. Roman law had been adopted throughout most of Europe by the end of the 1500's. But only England had a monarchy strong enough to establish a unified legal system. In other countries, law codes were drawn up and enforced mainly by local governments. These local codes differed greatly from one part of a country to another. Beginning in the 1500's, many European monarchs set out to form strong central governments. To help achieve this goal, they began to assemble the assorted local codes of their countries into national codes—a development called the *codification movement.*

The codification movement reached its peak under the French ruler Napoleon Bonaparte. In 1800, Napoleon appointed a committee of legal scholars to turn the whole of French private law into a compact, well-reasoned code. The new code, called the *Code Civil* or *Code Napoléon,* was a skilful blend of Roman law, French customs, and democratic philosophy. It went into effect in 1804 and has remained France's basic code of private law ever since. It has also been a model for the private-law codes of most civil-law countries. Thus, Roman law, as contained in the Code Napoléon, still influences people's lives.

English law in the colonies. When English settlers colonized countries, for example, the United States, Australia and parts of Africa, they continued to use English law. Many leaders in the colonies were lawyers who had been trained in the common law. These men were especially dedicated to the common-law principles that put the rights of the people above the will of a monarch. Therefore, when a country became independent the common law was a driving force behind the writing of the new country's constitution.

However, newly independent countries adopted the basic ideas, but not the whole body of English common law. Many parts of the common law were impractical for new, rapidly expanding nations. English property law was particularly unsuited in the United States, for instance. Land was scarce in England, and so the law heavily restricted the transfer of land from one owner to another. But much of the land in the United States was unsettled and the nation was constantly expanding its frontiers. To ensure the nation's growth, people had to be free to buy and sell land. American property law therefore began to stress the rights and obligations involved in land transfers. The English laws that restricted such transfers were discarded.

The legal systems of Australia, Canada (apart from Quebec), India, Malaysia, New Zealand, and the United States (apart from Louisiana), as well as many African and Caribbean nations, are all based on the English system, but have developed in different ways according to the needs and customs of each country. See **Australia, Legal system of.**

Related articles. See the *Government* section of the various country articles. See also the following articles:

Branches of private law

Business law

Antitrust laws
Attachment
Bankruptcy
Bill
Bill of exchange
Bill of lading
Bond
Business law
Common carrier
Conglomerate
Contract
Copyright
Credit
Debt
Garnishment
Guarantee
Interest
I.O.U.
Joint-stock company
Limited company
Moratorium
Negotiable instrument
Partnership
Patent
Pawnbroker
Power of attorney
Promissory note
Trademark
Usury

Tort

Assault and battery
Damages
Libel
Negligence
Slander
Tort
Trespass

Property law

Air rights
Appraisal
Assignment
Bill of sale
Deed
Easement
Encumbrance
Eviction
Lease
Lien
Mechanic's lien
Mortgage
Occupancy
Personal property
Property
Riparian rights
Squatter
Tenant
Title

Inheritance law

Antitrust-laws
Entail
Estate
Executor
Heir
Legacy
Next of kin
Probate
Will

Law students learn their skills in classrooms that give a realistic impression of the courtrooms in which they will work.

Family law

Adoption
Divorce
Guardian
Marriage
Ward

Branches of public law

Criminal law

Abandonment
Accomplice
Arson
Assassination
Bigamy
Blackmail
Breach of the peace
Bribery
Burglary
Conspiracy
Contempt
Counterfeiting
Crime
Embezzlement
Euthanasia
Extortion
Forgery
Fraud
Homicide
Juvenile delinquency
Kidnapping
Libel
Lynching
Manslaughter
Mayhem
Murder
Perjury
Polygamy
Riot
Robbery
Sabotage
Slander
Smuggling
Treason
Trespass
Vagrancy
Vandalism

Constitutional law

Bill of rights
Citizenship
Civil rights
Constitution
Magna Carta
Petition of Right

Administrative law

See the following articles and their lists of *Related articles:* **Local government; Taxation.**

International law

See **International law** and its list of *Related articles.*

Lawmaking

Code
Common law
House of Commons
House of Lords
Legislature
Lobbying
Parliament
Repeal
Veto

Legal procedures and terms

Affidavit
Appeal
Autopsy
Bail
Brief
Confession
Deposition
Equity
Evidence
Habeas corpus
Indictment
Injunction
Inquest
Judgment
Jury
Mandamus
Minor
Petition
Statute of limitations
Subpoena
Suit
Summons
Trial
Witness
Writ

Law enforcement

See the following articles and their lists of *Related articles:* **Court; Crime; and Police.**

History

Code Napoléon
Draco
Feudalism
Hammurabi
Inns of Court
Justinian Code
Lycurgus
Moses
Plato
Solon
Ten Commandments
Trial by combat
Twelve Tables, Laws of the

Other related articles

Civil disobedience
Civil law
Franchise
Impeachment
Legal aid
Maritime law
Martial law
Parliamentary procedure
Public opinion

Outline

I. Branches of law
- A. Private law
- B. Public law

II. Systems of law
- A. Common-law systems
- B. Civil-law systems
- C. Other systems

III. How laws are changed
- A. By court decision
- B. By legislation
- C. By administrative action
- D. By direct action of the people

IV. The development of law

Law, Andrew Bonar (1858-1923), a British statesman, served as prime minister from 1922 to 1923. He entered Parliament in 1900, and became leader of the Conservative Party in 1911. In December 1916, he refused the king's offer to try to form a new cabinet, and served under Prime Minister David Lloyd George, as chancellor of the exchequer. In 1922, Law and other Conservatives forced Lloyd George's resignation. Law was born in New Brunswick, Canada, but moved to Scotland when he was 12.

Law, John (1671-1729), a Scottish financier and gambler, tried to revive the French economy by opening a bank in 1716 to issue paper money. His plans also included land speculation and trade in the American state of Louisiana, which became famous as the *Mississippi Scheme.*

Law was born in Edinburgh. In 1694, he killed a man in a duel, and was arrested and sentenced to death. He escaped from prison and fled to the Dutch city of Amsterdam, where he studied the operations of the Bank of Amsterdam. He then accumulated a large fortune through gambling.

Law opened a bank in France in 1716. The paper money issued by the bank soon became readily acceptable. In 1717, Law established a company which soon monopolized trade with nearly all French possessions. In 1718, the bank became the Royal Bank.

Law's bank issued excessive quantities of paper money. Much of it was used to speculate in stock issued by his trading company. Speculators soon demanded gold for their paper money. The whole project collapsed, leaving thousands of people bankrupt in the panic that followed (see **Mississippi Scheme**).

Law court. See **Court.**

Law enforcement is the means by which a country or community maintains order. The enforcement of law, both civil and criminal, by government agencies enables society to live safely and in peace.

Civil law, which includes family and company legislation, deals with conflicts between corporations or private individuals. Contractual disagreements, property disputes, and personal injury claims are usually settled in local or county courts. Larger or more complicated cases are taken for trial before a senior judge in the high court.

Criminal law deals with activities that are considered a danger to society. *Defendants* (people charged with crimes) must be told the nature of the alleged offence. They must be given an open trial, and be allowed to call evidence on their own behalf. Trials are usually open to the public. However, some trials dealing with offences against young children, or involving state secrets, are held *in camera* (in private).

Arrest. The police have the power to arrest anyone whom they have reasonable cause to feel is committing, or has recently committed, a crime. If they wish to search a suspect's home or business premises for evidence, they must first obtain a search warrant. Once a defendant has been arrested, he or she may be held in *custody* (prison) or released on bail. The defendant must be brought before a court on the next working day. A defendant who has been held in custody may apply to the court to be released on bail until the next court appointment.

Trial. In countries such as Australia, India, Ireland, and the United Kingdom, which have the common law system of justice, most minor criminal cases are dealt with in the local magistrates court. Magistrates may be *stipendiary* (professional lawyers who hear the case on their own) or *lay* (private citizens without legal training who sit as a group).

Defendants accused of serious offences will be tried by a judge, sitting with a jury. The defendant first appears before a junior court to establish that there is a case to answer. This is usually a formality. But the entire evidence may be presented in the junior court at the defendant's request. Once the junior court has established that there is sufficient evidence to warrant a trial, the defendant is remanded in custody or on bail, until his case can be presented before the judge. A defendant who is not satisfied with a judge's interpretation of the law may appeal to have the case heard again before a more senior judge, or before a panel of judges, in a higher court.

Imprisonment. Most criminal laws specify the longest and shortest prison term to which an offender may be sentenced. The judge decides the exact length of the sentence, depending on what he or she feels will best serve both the offender and society. Prison terms are meant to punish offenders, reform criminals, remove dangerous offenders from society, and show possible future lawbreakers the penalties for crime.

If the judge believes a prison term would not help an offender, the individual may be sentenced to a period of probation. A lawbreaker who is on probation remains free, but a probation officer assigned by the court may check on the individual's activities. An offender who violates the rules of the probation may be imprisoned.

Related articles in ***World Book*** include:

Arrest
Bail
Civil law
Court
Hypnotism (Uses of
  hypnotism)
Indictment
Interpol
Jury
Law
Parole
Plea bargaining
Police
Prison
Sentence
Trial
Warrant

Lawler, Ray (1922-), an Australian dramatist, wrote the highly successful play *Summer of the Seventeenth Doll.* It was first performed in Melbourne in 1955 and in London in 1957. This brilliant character play marks the establishment of the realist play in Australian literature. It deals with a group of cane cutters and barmaids in a city slum, exploring the accepted Australian myth of the superiority of the rugged outdoor type of man. The plot is entertaining, taking unpredictable turns and ending unconventionally. The touches of irony, wisdom, and humour in the dialogue add to the play's realistic effect. Tense situations, clearly defined characters, significant dialogue, and brilliant movement and structure make this play a vivid and effective drama. Lawler's characters speak what seems to be authentic, casual, Australian speech.

Lawler later wrote two more plays with the same characters, forming a trilogy. His other plays include *The Piccadilly Bushman* (1959) and *The Unshaven Cheek* (1963).

Raymond Evenor Lawler was born in Melbourne. He left school at the age of 13 and worked for an engineering firm. Later, he became a stage manager and then an actor and producer.

Lawless, Theodore Kenneth (1892-1971), a black American doctor, became known for his work in the field of *dermatology* (the study of skin diseases). He helped develop cures for several rare and baffling skin diseases. He also worked actively for many civic organizations. Lawless won the 1954 Spingarn medal. He was born in Thibodaux, Louisiana, U.S.A. and received his medical degree from Northwestern University. He taught dermatology at Northwestern from 1924 to 1941, and also did research there.

Lawn is an area or plot of ground that has a thick covering of closely cut grass. A lawn may surround a house or block of flats, or it may form part of the landscape around a public building. Lawns also serve as recreation areas in parks and playgrounds.

People grow lawns for several reasons. Lawns beautify the surroundings and help prevent soil erosion. In hot weather, they cool the air near the earth's surface. They also reduce noise pollution by absorbing sound.

Growing a lawn

A successful lawn should grow evenly, and its colour and texture should both be uniform throughout. Before starting a lawn, be sure the site is well drained and fairly smooth. It may be uneven but should have no steep slopes. Next, follow certain steps in preparing the soil and planting the grass.

Preparing the soil. Plan to prepare the soil at least a week before planting the grass. First, grade the site by removing all topsoil. A small tractor with a special blade attached may be used for a large area. Such a tractor can be rented from a garden supply centre. Or, you may use a hoe, a rake, a shovel, a spade, or some other gardening tool to remove the topsoil. Be sure to pile up the topsoil as it is removed. It will later be used to cover the subsoil that is exposed during the grading process. In addition, be sure to remove any debris, such as rocks, sticks, and clods of soil.

After grading the lawn site, replace the topsoil. To make sure the topsoil has the needed *nutrients* (nourishing substances), add a layer of organic material. The best kind is *compost*—a mixture of partly decayed plant material and soil. In addition, apply 1 to 2 kilograms of mineral fertilizer per 10 square metres of land. Mineral fertilizer, which dissolves, will nourish the subsoil as well as the topsoil (see **Fertilizer** [Kinds]). Mix the fertilizer and soil with a rotary tiller to a depth of 10 to 15 centimetres. Then, rake and level the soil before planting the grass.

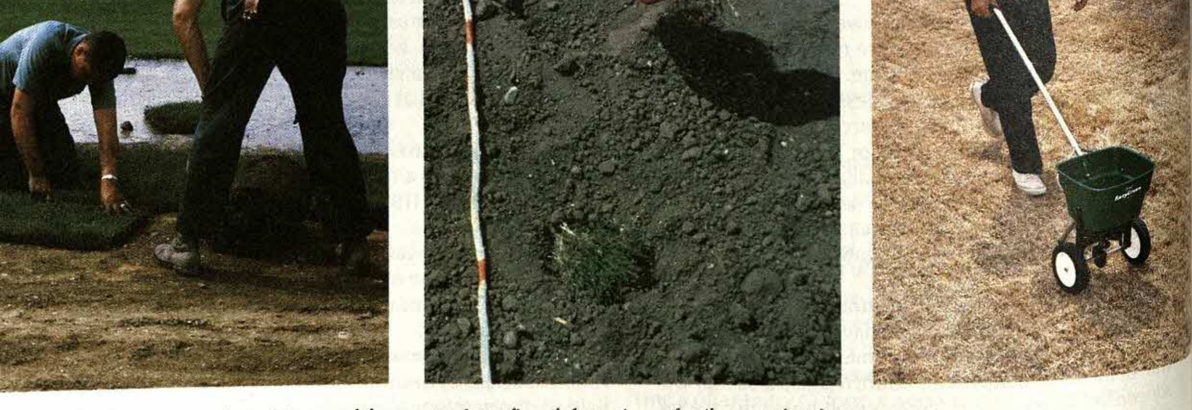
Planting the grass. Be sure to use a variety of grass that is suitable for the climate. Bent grass, a fairly common lawn grass, can grow in acid soil that has poor drainage. However, people seldom use bent grass for home lawns because of the high cost of maintaining it.

Lawn grasses that grow well in cool, humid areas include meadow grass, fescues, and bent grass. In a coarse lawn, white clover may be planted with them to improve the fertility of the soil. Many commercial seed mixtures for cool, humid regions contain some ryegrass seed. Such seed grows quickly and produces a lawn rapidly. But ryegrass lives only a short time before it disappears, leaving room for the longer-lasting grass in the seed mixture. For this reason, ryegrass is sometimes called *nurse grass.*

One common lawn grass in warmer climates is Bermuda grass which is also used for binding loose soil in southern Europe. In Australia it is known as couch grass. In South Africa and in parts of the U.S.A., the closely related Uganda grass is also used.

Grass can be planted in three ways: (1) seeding, (2) turfing, or (3) sprigging.

Seeding is the commonest and cheapest method of planting grass. The seeds can be distributed by hand on most lawn sites. For large areas, you should use a push-type seeder, which can also be used to spread grain-type fertilizers and pesticides.

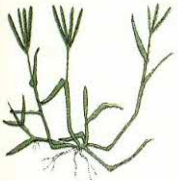


Most lawns are planted in one of three ways. In turfing, *left,* sections of soil covered with grass are laid on the ground. Sprigging, *centre,* starts a lawn with plugs of grass that spread to cover the entire lawn area. Seeding, *right,* can be done with a mechanical seed spreader.

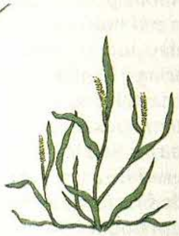
Lawn enemies

Weeds

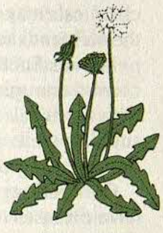
The plants shown below are lawn weeds. They may be removed by hand or with tools, or they can be controlled with chemicals. Manufacturers make a variety of substances that kill weeds or prevent their growth. Such products may be spread or sprayed onto the lawn. Some of them affect only weeds, but others also include a fertilizer that nourishes the grass.



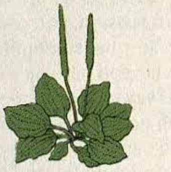
Crab grass



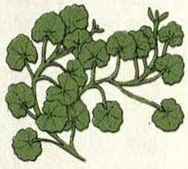
Foxtail



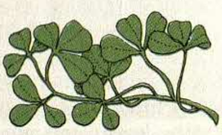
Dandelion



Plantain



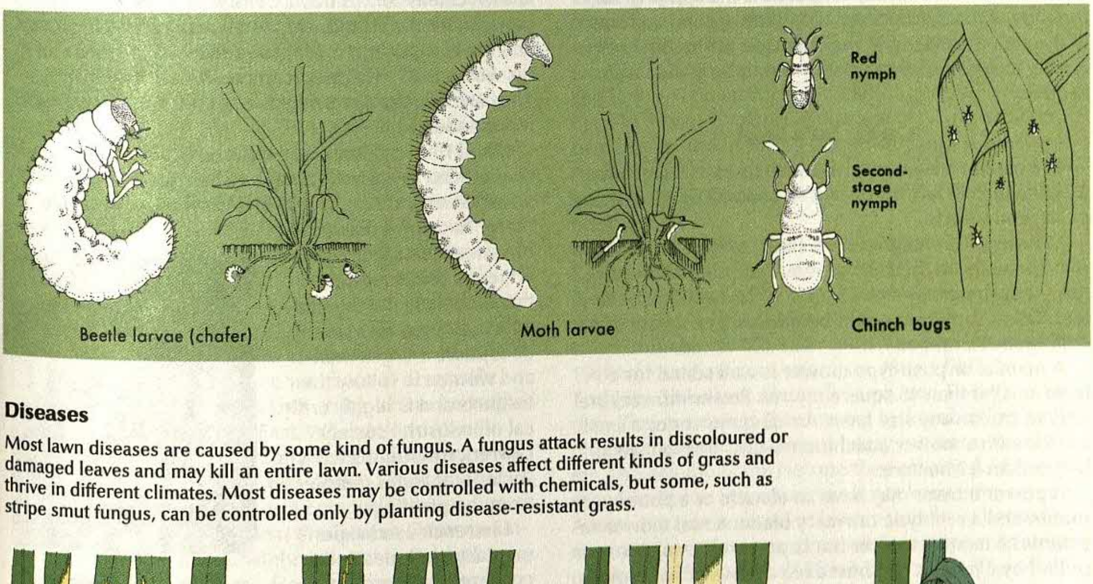
Ground ivy



Clover

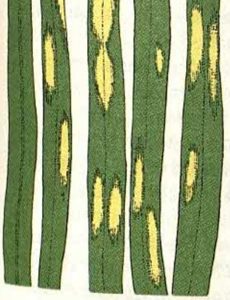
Insects

Common lawn pests include beetle larvae, such as chafers, moth larvae, and bugs. Beetle larvae feed on the roots of grass. Moth larvae eat plant leaves and stems. Chinch bugs damage leaves by sucking the juice from them. The larvae of craneflies, known as leatherjackets, are another pest feeding on the roots of grasses.

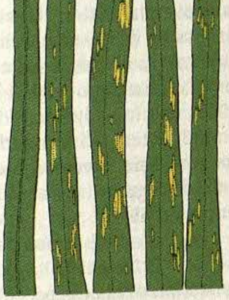


Diseases

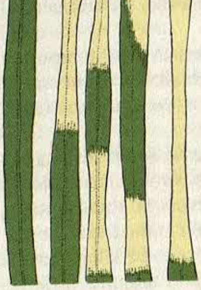
Most lawn diseases are caused by some kind of fungus. A fungus attack results in discoloured or damaged leaves and may kill an entire lawn. Various diseases affect different kinds of grass and thrive in different climates. Most diseases may be controlled with chemicals, but some, such as stripe smut fungus, can be controlled only by planting disease-resistant grass.



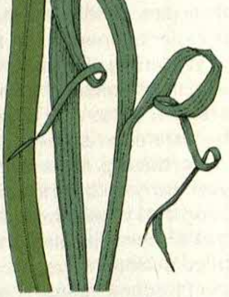
Leaf spot fungus



Rust fungus



Dollar spot fungus



Stripe smut fungus

The best time to sow seed is in early autumn or early spring. First, divide the seed into two equal amounts. Sow half the seed by walking back and forth over the soil. Sow the other half by walking at right angles to the first direction. Cover the seed by raking the soil lightly, but be sure not to bunch the seed. Roll the soil lightly to provide a compact surface. You may cover the soil with a light layer of clean straw. This cover, called *mulch,* helps conserve moisture, prevent erosion, and protect the seedlings from drying out. Water the soil lightly and frequently until the lawn has developed fairly well.

Turfing is the most expensive way to plant grass. Sections of soil already covered with grass are commonly known as turf. Turf is dug up and carried to the lawn site where it is laid over the soil. This method is used mostly on small areas where grass is needed quickly, or on slopes that would otherwise erode.

Select the turf carefully, making sure that it contains as little straw, leaves, and other plant matter as possible. An accumulation of plant matter on the soil's surface blocks water and nutrients that the grass needs to grow. Turf may be obtained from a garden supply centre or a professional landscaper. Most turf is laid by professionals.

Sprigging involves the use of *sprigs* (small chunks or cuttings of grass). Sprigs are planted at various intervals, depending on the variety of grass. As the sprigs grow, their low-lying stems creep along the ground and root in the soil, thus filling in the lawn site. Sprigging is used chiefly in regions where grass cannot be grown from seed.

Caring for a lawn

The care of a lawn involves such tasks as (1) mowing; (2) watering; (3) fertilizing; and (4) controlling diseases, pests, and weeds.

Mowing. The height to which grass should be cut depends chiefly on the kind grown. For example, bent grass may be mowed to a height of 2.5 centimetres or less. Other varieties should be mowed to a height of 4 centimetres or more.

A manual or push-type mower is well suited for a lawn smaller than 45 square metres. Power mowers are easy to use on any size lawn. A riding mower or a small tractor with a mower attachment works best on lawns larger than 0.2 hectare.

A power mower may have an electric or a petrol motor, and a reel-type or rotary blade. A reel mower resembles a manual mower but is powered by a motor or pulled by a tractor. It is best used on lawns that require close cutting. A rotary mower has a propellerlike blade that spins rapidly. It costs less than a reel mower, and it is easier to operate and maintain.

Watering of lawns is unnecessary in most temperate climates because of the normal rainfall. But in very dry areas, or those with hot summers, a lawn may have to be watered every day.

Fertilizing. Most lawns must be fertilized twice a year. Early each spring and autumn, spread from 5 to 10 kilograms of mineral fertilizer on every 90 square metres of lawn. The amount of nitrogen in the fertilizer applied during one year should not exceed 2 kilograms per 90 square metres. Be sure to distribute the fertilizer evenly, which can best be done with a push-type spreader. Fertilizer should be applied in much the same way as grass seed is sown. When the spreader is stopped or turned around, remember that it should be turned off. This will prevent too much fertilizer from falling on one area.

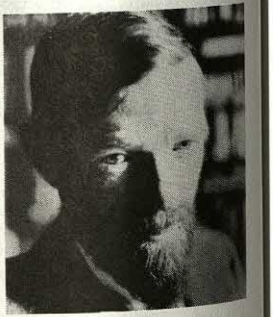
Using too much chemical fertilizer can harm the lawn and the environment. For example, overfertilizing with chemicals may produce grass with shallow roots. And the soil tends to compact tightly where roots do not penetrate. Such conditions prevent the grass from receiving enough water and nutrients. Overfertilization with chemicals also may pollute *ground water,* which supplies wells and springs. People can avoid these dangers by using organic fertilizers.

Controlling diseases, pests, and weeds. Common lawn diseases include rust and leaf spot. Like most lawn diseases, they are caused by a type of fungus. Such diseases may be controlled by fungicides. Pests that may infest lawns can be kept under control with insecticides. The most common lawn weeds include clover, and dandelions. They probably cannot be prevented from growing. But they can be kept from spreading by applying weedkillers or by digging out their roots with a V-pointed knife.

Lawn tennis. See Tennis (The court).

Lawrence, D. H. (1885-1930), was an English writer known chiefly for his novels. His fiction shows deep concern for the relationships between men and women and the complications of these relationships. Many of his works deal with people in conflict with themselves. They are frequently torn by the need for both love and independence.

David Herbert Lawrence was born in Eastwood, a coal-mining town in Nottinghamshire. His first major novel, *Sons and Lovers* (1913), describes his early life there. This novel, like most of Lawrence's other works, criticizes social attitudes that he believed were filled with hypocrisy and self-deception. It urges men and women to follow their instincts and is highly critical of industrial society. Lawrence thought such a society separates people from their feelings.


D. H. Lawrence

Lawrence used experimental techniques and unconventional themes that made him one of the most controversial authors of his time. For example, his frank discussion of sexual passion shocked many readers, and some of his novels were considered obscene. Lawrence's most famous novel, *Lady Chatterley's Lover* (1928), was initially banned from publication. In the United States, a shortened version appeared in 1944 but the complete novel was not published until 1959. In the United Kingdom, it was released only in 1961 after a lengthy trial.

Lawrence's other novels include *The Rainbow* (1915), *Women in Love* (1920), and *The Plumed Serpent* (1926). A collection of his essays called *Studies in Classic American Literature* (1923) ranks as a classic of literary criticism. Lawrence wrote many short stories, including "The Captain's Doll," "The Fox," "St. Mawr," "The Man Who Died," "The Rocking Horse Winner," "The Virgin and the Gypsy," and "Odour of Chrysanthemums." In addition, Lawrence wrote poems and plays.

Lawrence suffered from tuberculosis and travelled widely in an effort to improve his health. He made several trips to Australia, Italy, and Mexico, and these journeys supplied the background for many of his works.

Lawrence, Ernest Orlando (1901-1958), an American physicist, helped develop the *cyclotron,* a machine for accelerating atomic particles. He received the Nobel Prize for physics in 1939 and the 1957 Enrico Fermi award of the Atomic Energy Commission.

Lawrence started construction of a huge cyclotron before World War II (1939-1945), and converted it during the war to separate the isotopes of uranium. In 1946, he completed this *synchro-cyclotron,* which speeds particles to an energy of 400 million electron volts. In 1948, it produced the first artificially created *mesons* (see **Meson**). In 1954, he and other scientists completed the *bevatron,* a particle accelerator that produces energy up to 7 billion electron volts. Lawrence was born in Canton, South Dakota.

See also **Cyclotron; Synchro-cyclotron; Lawrencium.**

Lawrence, Marjorie (1907-1979), an Australian soprano, overcame an attack of poliomyelitis to sing at the Metropolitan Opera in New York City. She was born at Dean's Marsh, in Victoria, and went to Paris to study singing in 1928. After singing at the Paris Opera and other European opera houses, she made her debut at the Metropolitan in 1935. In 1941, she contracted poliomyelitis, but returned to the Metropolitan in 1942. After 1956, she taught in the United States. Her autobiography, *Interrupted Melody* (1949), was made into a film.

Lawrence, T. E. (1888-1935), a British soldier and writer, became world famous as *Lawrence of Arabia.* He was one of the most adventurous personalities of World War I (1914-1918). In *The Seven Pillars of Wisdom* (1926), he described his exploits in Arabia. A shortened version of his book appeared in 1927 as *Revolt in the Desert.*

Thomas Edward Lawrence was born in Tremadoc, Wales. He attended Oxford University, where he studied archaeology and the Near East. When World War I started, Lawrence was working as an archaeologist for the British government. He was sent to Egypt to head military intelligence. Later, as a colonel, he helped organize the Arab revolt against the Turkish Ottoman Empire, and became passionately devoted to the Arab cause. He won success as a leader of daring guerrilla raids. His military and diplomatic genius led to the defeat of the Turks and the entry of the Arabs into Damascus, the capital of Syria. Lawrence refused all honours and decorations. But the Arabs hailed him as a hero, and he was called "the uncrowned King of Arabia." At the Versailles Conference in 1919, he unsuccessfully pleaded the cause of Arabian independence.

In 1921, Lawrence became adviser on Arab affairs to the British Colonial Office, but he was disappointed in the treatment of the Arabs. Feeling that his failure had betrayed his friends, he resigned the next year and enlisted in the Royal Air Force (RAF) under the name of J. H. Ross. His identity was discovered, and he transferred to the tank corps under the name of T. E. Shaw. In 1925, he returned to the RAF. He legally adopted the name of T. E. Shaw in 1927. Lawrence was discharged from the RAF in February 1935. He was killed in a motorcycle accident in Dorset, England, three months later.

Detail of an oil portrait on canvas by Augustus John; Imperial War Museum, London

T. E. Lawrence—the famous *Lawrence of Arabia*—fought for Arabian independence. The Arab people hailed him as a hero.

Lawrence, Sir Thomas (1769-1830), was one of the most successful portrait painters of his time. He succeeded Sir Joshua Reynolds in 1792 as painter to George III. Many of his portraits hang in Windsor Castle and in the National Portrait Gallery, London. He was born in Bristol, England. At the age of 12, he had his own studio, and at 18 had begun studying at the Royal Academy. He was elected a Royal Academician in 1794, knighted in 1815, and made president of the Royal Academy in 1820.

Lawrence of Arabia. See **Lawrence, T. E.**

Lawrencium (chemical symbol, Lr) is an artificially created radioactive element. It was named in honour of the American physicist Ernest O. Lawrence. It has an atomic number of 103. Lawrencium was discovered in 1961 by four American scientists, Albert Ghiorso, Torbjørn Sikkeland, Almon E. Larsh, and Robert M. Latimer. They produced the element by bombarding californium with boron ions from a heavy-ion linear accelerator. The half-life of the isotope they obtained was eight seconds, but its mass number is not known for certain. A total of eight isotopes of lawrencium have been discovered. One of its two most stable isotopes has a mass number of 256 and a half-life of 28 seconds. The other has a mass number of 260 and a half-life of 3 minutes. Lawrencium is the last member of the *actinide series* of the periodic table.

See also **Transuranium element.**

Lawson, Ernest (1873-1939), was an American painter. His style was strongly influenced by his contact with the American impressionist painters John H. Twachtman and J. Alden Weir. But unlike these artists, Lawson used the impressionist style to express his own feelings. He portrayed city scenes through rugged, simple forms.

Lawson's sense of independent expression typified artist Robert Henri's own conception of art. Lawson joined a group of realistic painters headed by Henri, and called *The Eight* (later the *Ashcan School*). The

Ernest Lawson's *High Bridge* was painted in 1934. It shows the influence of impressionism on this American realistic artist.

group exhibited together in 1908. For more information on the group, see **Ashcan School.** Lawson was born in San Francisco.

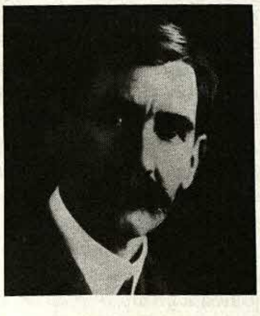
Lawson, Henry (1867-1922), a short-story writer and poet, is Australia's most famous and popular writer. His portrait appears on Australia's ten-dollar note.

Lawson's works include *While the Billy Boils* (1896), *In the Days When the World Was Wide* (1896), *On the Track* (1900), *Over the Sliprails* (1900), *Joe Wilson and His Mates* (1901), *Children of the Bush* (1902), *When I Was King* (1905), and *Mateship* (1911).

Lawson wrote of the struggles of people in both the country and the city. He could write about the hard life in the bush because of the harsh poverty and backbreaking labour he had experienced on his family's farm, and from his travels as a *swagman* (tramp). He was a realist, a champion of the underprivileged, and a believer in *mateship*—fellowship based on equal opportunity for all. He envisioned the destruction of people by people in the city and of people by nature in the bush.

Poems written by Lawson have had great popularity. But they have been criticized for sentimentality, trite language, and clumsy use of metre and rhythm. Lawson's ballads ignore narrative in favour of character description and personal comment. Lawson's real genius shows in his short stories. His prose has freshness and interest because he was not influenced by other writers. Lawson wrote forcefully about his own experiences and first-hand observations. His technique was masterly, his style economic, and his sincerity clear.

Lawson's deep feeling for the people of the outback is illustrated in stories such as "The Drover's Wife" and "Water them Geraniums," in which Lawson immortalised the courage, endurance, and acceptance of the bush women of his time. The stories generally are quite short and are told in the first person. The easy, colloquial language is strong and detailed. The stories contain the same humour and sentiments that are found in Lawson's verse, with even more emphasis on the concept of mateship. Lawson was not greatly concerned with plot, but developed his themes through his characters. Of his few purely funny stories, "The Loaded Dog" is most famous. Lawson's mastery of the short-story technique influenced other short-story writers.



Henry Lawson

Lawson was born in the goldfields near Grenfell, in New South Wales. He was the son of a Norwegian farmer. The family name was originally Larsen. His mother became an active worker for women's rights and started the magazine *Dawn.* Lawson had an unhappy childhood because his family was poor and his parents frequently quarrelled. He received a sketchy education and tried, but failed, to enter Sydney University. On leaving school, he helped on the family farm.

From 1887 Lawson contributed stories and verse to *The Bulletin.* During 1892, he *carried his swag* (tramped) from Bourke to Hungerford, and the following year, worked in New Zealand. In 1894, his mother's press published his first book, *Short Stories in Prose and Verse.* Lawson was married in 1896, but became separated from his wife after an unhappy, homesick period in London. The final years of Lawson's life were difficult due to his poverty, ill health, and heavy drinking.

Lawson, Nigel (1932-   ), a Conservative politician, was Britain's chancellor of the exchequer from 1983 to 1989. He had been financial secretary to the Treasury from 1979 to 1981, and was secretary of state for energy from 1981 to 1983.

Lawson was educated at Westminster School and Oxford University. After service in the Royal Navy, he became a financial journalist and broadcaster. Lawson edited *The Spectator* from 1966 to 1970. During 1963 and 1964, he served as special assistant to Prime Minister Sir Alec Douglas-Home. Lawson became member of Parliament for Blaby, Leicestershire, in 1974. He was opposition spokesman on economic affairs from 1977 to 1979. In 1992 he was made a life peer.

Lord Lawson

Lawson, William (1774-1850), an Australian explorer, crossed the Blue Mountains in May 1813, with Gregory Blaxland and William Charles Wentworth. Lawson was born in London. He travelled to Sydney as an ensign with the New South Wales Corps in 1800. In 1808 and 1809, he was in charge of the settlement at Newcastle. He was commander of the Bathurst settlement from 1819 to 1823 and explored as far north as Mudgee. From 1843

William Lawson

to 1848, Lawson was an active member of the Legislative Council in New South Wales.

Lawyer is a man or a woman who is allowed to represent members of the public in a court of law or to advise them on matters of law. A person who seeks a lawyer's services is called a *client*. Under the English legal system, a lawyer who has the right to argue cases in higher courts is called a *barrister*. One who does not is called a *solicitor*. This system is used throughout the United Kingdom. But in Scotland, a high-court lawyer is called an *advocate*. The system of barristers and solicitors was used in Australia, India, Ireland, New Zealand, South Africa, and many Commonwealth countries. But in recent years, many countries have formally abolished this system. In those countries, most lawyers either specialize in *advocacy* (appearing in court) or choose more general advisory work.

A lawyer's duties may cover many legal matters, including contracts, wills, personal injuries,and business affairs. A lawyer tries to avoid litigation by giving legal advice that will keep the client out of trouble, and by trying to settle cases amicably. Legally, anyone may act on his or her own behalf in any court. But authorities say that it is not wise for an untrained person to do so, except in small claims courts or other courts where procedure is informal.

Learning to become a lawyer requires several years of study. It also includes a period of time working with another lawyer to learn the practical side of the work.

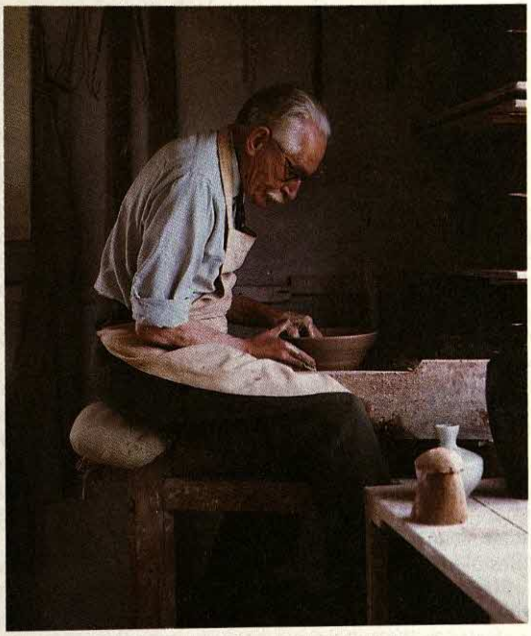
Laxative is a medicine that speeds the emptying of the *bowels* (intestines). *Mineral oil* is a laxative that helps empty the bowels by lubricating the bowel contents. *Phenolphthalein,* the active ingredient in chewable and chocolate laxatives, has a direct effect on the intestine, but how it works is not clear. Some laxatives, including *Epsom salts,* provide bulk in the form of retained water. The water increases the bowel contents and forces the bowels to empty. Other laxatives, including *castor oil,* act by irritating the walls of the bowels. Laxatives should not be taken continually over a long period of time because the bowels may become lazy and fail to function on their own. Laxatives may also cause harmful side effects in other parts of the body. They should never be taken by people who have abdominal pain. *Constipation* (infrequent bowel movements) can often be relieved by drinking ample quantities of water and by eating foods containing fibre. These foods include cereals, whole fruits, and leafy vegetables.

Related articles in ***World Book*** include:

Cascara sagrada
Castor oil
Constipation
Glauber's salt
Magnesia
Mineral oil
Phenolphthalein

Lazarus, in the account of John 11 in the Bible, was the brother of Mary and Martha of Bethany. He was raised from the dead after four days by Jesus Christ. The English poets Lord Tennyson and Robert Browning used this story in poems. The American dramatist Eugene O'Neill wrote *Lazarus Laughed* (1927), a play about Lazarus after he was brought back to life. The name also belongs to a beggar in the New Testament parable of the rich man and Lazarus (Luke 16: 19-31).

Lazear, Jesse William (1866-1900), an American doctor, became known for his work in controlling yellow fever. In 1900, an outbreak of yellow fever occurred in Havana, Cuba. Lazear was appointed a member of the Yellow Fever Commission, along with Walter Reed, James Carroll, and Aristides Agramonte, to study the disease. The four men proved that the bite of a mosquito transmitted yellow fever. During the course of their experiments in Cuba, Carroll submitted to the bite of an infected mosquito, developed yellow fever, and recovered. Lazear was bitten accidentally by an infected mosquito and died of yellow fever. Shortly after his death, the disease came under control. Lazear was born in Baltimore, Maryland, and graduated in medicine from Columbia College.



Bernard Leach became famous for the beautiful pottery he created in his studio at St. Ives.

Lazurite. See **Lapis lazuli.**

L-dopa. See **Parkinson's disease.**

Leach, Bernard (1887-1979), was a leading British artist potter. He was greatly influenced by Japanese traditions of pottery. He founded the Leach Pottery at St. Ives, in Cornwall, in 1920. Leach was born in Hong Kong, and travelled to Britain in 1897. He entered the Slade School of Art, in London, in 1903. From 1909 to 1920, he lived in Japan, learning the art of pottery.

Leaching. See **Metallurgy** (Leaching).

Leacock, Stephen Butler (1869-1944), ranks as the most popular humorist in Canadian literature. He also wrote serious works and was a distinguished professor of political science. The majority of Leacock's humorous works poke fun good-naturedly at everyday people and events by treating them with mock seriousness. In addition, he wrote many *parodies,* which are humorous imitations of other authors' styles of writing.

Most of Leacock's humorous writings first appeared as essays and short stories in magazines and newspapers. The first of the many collections of his humorous works, *Literary Lapses,* was published in 1910. About 35 of Leacock's more than 60 books were humorous, but he also wrote biographies and works on political science, economics, history, and literary criticism.

Leacock was born in Swanmore, near Southampton, England. His family moved to a farm near Lake Simcoe, Ontario, Canada, when he was 6 years old. Leacock taught political science at McGill University from 1901 until he retired in 1936. His unfinished autobiography, *The Boy I Left Behind Me,* was published in 1946 after his death.

Lead, a heavy, bluish-grey chemical element, is one of the world's oldest known metals. Its chemical symbol, Pb, comes from the Latin word for lead, *plumbum.* People have used lead for thousands of years as a building material, for water piping, and to make pottery and other objects. Today, lead is important to many industries, especially to those that produce chemicals, nuclear energy, and petroleum.

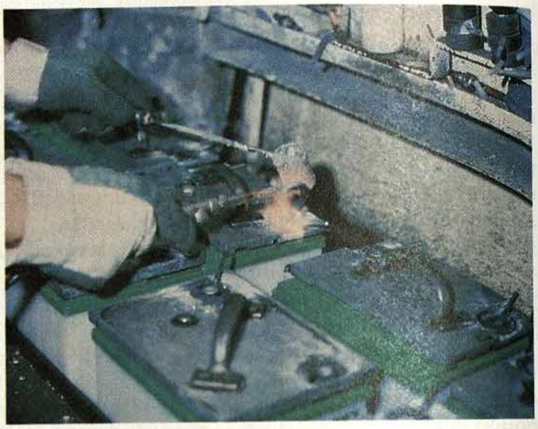
In spite of its usefulness, lead can be harmful. If too much lead builds up in the body, a condition called *lead poisoning* can result. This condition occurs chiefly among people who work in certain chemical plants or other factories or refineries where there are large quantities of lead fumes or dust in the air.

The amount of lead used is significantly greater than the quantity of lead mined. Annual lead use worldwide is about 6 million metric tons, but yearly lead production from mines is only about 3 million metric tons. The rest is obtained by recycling lead from scrap products. Australia is the leading lead-mining country. The United States, China, and Canada are also leading lead producers.

Properties. Pure lead is soft and has little strength. As a result, lead producers often *alloy* (mix) it with small amounts of other metals to form *lead alloys.* The added metals, such as antimony and tin, increase the strength of lead and give it other properties. Lead also combines chemically with chlorine, oxygen, and other elements to form various compounds. For example, it combines with sulphur to produce lead sulphide, also called *galena.*

Lead is highly *malleable*—that is, it can be hammered or pressed into thin sheets. Lead also possesses great *ductility,* the ability to be permanently stretched without breaking. It resists corrosion by water and by sulphuric acid and other powerful chemicals. Lead is a poor conductor of electricity. Lead has an atomic weight of 207.19, and its atomic number is 82. Lead melts at 327.5° C and boils at 1740° C. At 20° C, its density is 11.35 grams per cubic centimetre (see **Density**).

Lead, *foreground,* is refined mainly from *galena,* a grey metallic ore, *background.* Much lead is also obtained by recycling scrap products such as car batteries.



Lead-acid storage batteries make up the largest single use of lead. The worker above is making and installing lead terminal posts for the batteries.

Uses. The largest single use of lead is in the manufacture of lead-acid storage batteries. These batteries contain pure lead and lead compounds, and certain parts of them are made of a lead-antimony alloy. Storage batteries provide power for the electrical systems of aeroplanes, cars, and many other vehicles. See **Battery** (Lead-acid storage batteries).

Lead also is used in the production of *tetraethyl lead,* an ingredient added to petrol to improve the performance of certain car engines. But the burning of tetraethyl lead in engines also produces chemicals that contribute to air pollution. See **Tetraethyl lead.** Many industrialized countries have introduced lead-free petrol.

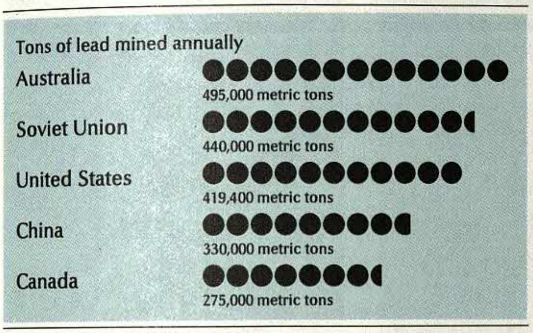
Several lead compounds are important to the manufacture of some paints and dyes. For example, paints made with the lead compounds called red lead and white lead are applied to bridges and other steel structures to prevent corrosion. Manufacturers also use lead compounds in explosives and insecticides and in ceramic, glass, and rubber products.

Lead alloys have a wide variety of uses. Cable coverings made with lead alloys protect telephone and power lines from moisture and corrosion. Manufacturers of cars and electronic products use a lead-tin alloy called *solder* to join metal surfaces. Producers of heavy machinery use a lead alloy called *babbitt metal* to produce bearings. Bearings are machine parts that reduce friction between moving parts (see **Babbitt metals**).

Lead's strong resistance to corrosion makes it especially important to the chemical industry. Pipes, storage tanks, and other equipment made of lead alloys are used for shipping and storing certain chemicals.

The high density of lead makes it a good shield against radiation. Sheets of lead alloys line the walls of hospital X-ray rooms, nuclear reactors, and other facilities in which radioactive materials are present. In addition, radioactive wastes are placed in lead containers for shipment and disposal.

Leading lead-mining countries



Figures are for 1989. Source: U.S. Bureau of Mines.

Hazards of lead. People take lead into their bodies through the *inhalation* (breathing in) or *ingestion* (swallowing) of lead particles, or through the absorption of these particles through the skin. The danger of lead poisoning is greater when an individual is exposed to lead over a long period of time.

Lead interferes with the production of red blood cells and may damage the brain, kidneys, liver, and other organs. Many victims of lead poisoning suffer fatigue, headaches, stomach cramps, and other symptoms. Severe cases of overexposure to lead may be fatal, but such reported cases of this condition are rare.

Major sources of lead pollution include the exhaust from cars that burn leaded petrol and the dust and fumes released by industrial plants that use lead. Many children who eat chips of dried paint with a high lead content develop lead poisoning. Such paint is found in many older buildings. Lead water pipes, also found in older buildings, may cause poisoning. Many governments now restrict the amount of lead in paint and petrol, as well as the amount of lead released into the air.

How lead is obtained. Nearly all lead ores are produced from underground mines. Many minerals contain lead, but the principal source of the element is galena, a grey metallic ore. In its pure form, galena consists of only lead and sulphur. However, it rarely occurs in such a form in nature. Instead, most deposits of galena, like those of most other lead ores, contain some copper, gold, silver, and zinc.

After galena is mined, dirt, rocks, and other substances are *concentrated* (separated) from the ore. Most lead refiners concentrate ore by a process called *flotation.* In this process, the ore is crushed and then placed in a tank that contains a flotation chemical, such as copper sulphate or oil. The chemical causes the ore to rise to the top of the tank and particles of dirt and rock to sink. Workers then skim off the concentrated ore from the surface.

Next, the concentrated ore is roasted in a smelter. During the roasting process, the sulphur in the ore combines with oxygen and escapes as sulphur dioxide gas. In addition, the lead in the ore combines with oxygen to form particles of lead oxide. Additional heat is applied to the lead oxide, causing the particles to *sinter* (join together) into hard lumps.

Workers mix the sintered lead oxide with lumps of coke and feed the mixture into the top of a blast furnace. Inside the furnace, the burning coke reacts with the lead oxide to produce liquid lead. Waste products, called *slag,* are separated from the metal before it reaches the bottom of the furnace.

The crude lead that comes from the blast furnace contains such metals as copper, gold, and silver. Refiners use several methods to purify the lead. Copper normally collects on the surface of liquid lead that has cooled slightly. Workers simply skim off the top to remove the copper. Gold and silver are removed by reheating the lead and adding zinc. The precious metals dissolve more easily in zinc than in lead. When the lead cools, workers remove a zinc crust, which contains most of the gold and silver.

See also **Galena; Lead poisoning.**

Lead monoxide. See **Litharge.**

Lead pencil. See **Graphite; Pencil.**

Lead poisoning is an illness caused by excess lead in the body. It may result from swallowing objects that contain lead or from inhaling lead dust or fumes. Some forms of lead can be absorbed through the skin.

Lead poisoning afflicts many children who eat chips of dried paint that has a high lead content. Such paint is found in many older homes. Lead poisoning also strikes adults who work in smelting, battery manufacturing, and other industries that use lead. Such industries may pollute the environment with lead dust and fumes, which may cause poisoning in people who live near the plants. Another source of lead pollution is the exhaust from vehicles that use leaded petrol.

Lead interferes with the production of red blood cells and may damage the brain, liver, and other organs. Symptoms of lead poisoning include anaemia, headaches, irritability, and weakness. Many victims also experience abdominal pain, vomiting, and constipation, a group of symptoms sometimes called *painter's colic* or *lead colic.* In severe cases, victims may have convulsions, enter a coma, and become paralysed. Such cases may be fatal.

In the late 1970's, researchers found that even small amounts of lead absorbed by the body over a long period can harm a child. Although such absorption does not cause physical illness, it can damage a child's brain and result in learning difficulties.

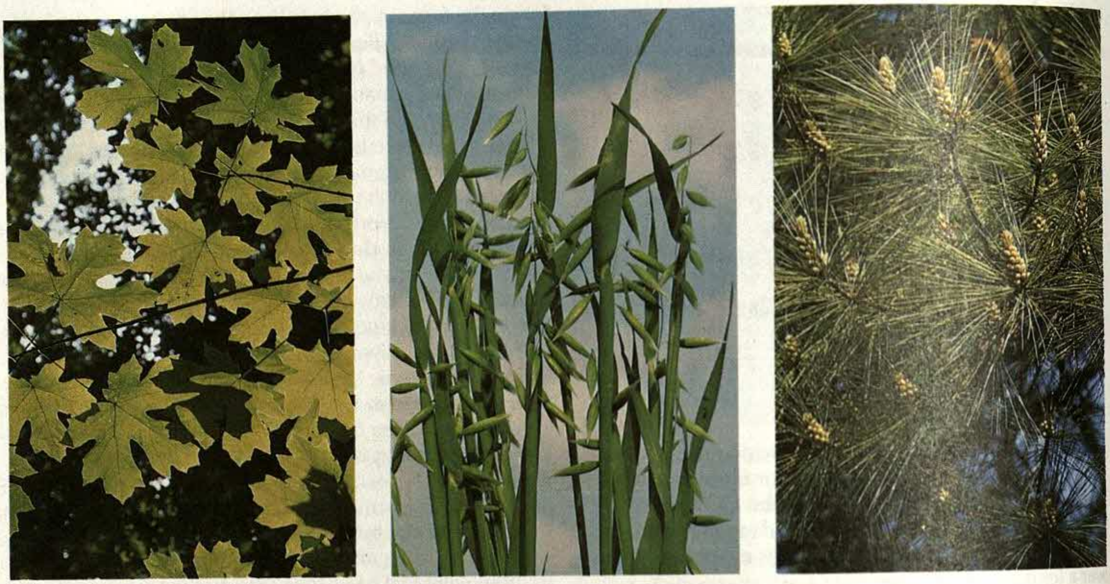
Doctors can detect lead poisoning by testing samples of a person's urine or blood and by taking X rays of the bones. If the illness is detected early, permanent damage may be prevented. Doctors in some countries recommend that children between 1 and 6 years old be tested for lead poisoning at least once a year.

Doctors treat lead poisoning with drugs that help the body discharge lead through the urine. Treatment may last several months. Many cases of lead poisoning can be prevented by reducing the amount of lead in the environment. Some governments restrict the lead content of paint and certain other products and regulate industrial uses of lead. Such governments also set air quality standards that limit the amount of lead that can be released into the air. In addition, many countries are reducing lead levels in petrol, and encouraging the use of lead-free petrol.

Leader. See **Fishing** (Leaders).

Leader of the Opposition. See **Parliament.**

Leadwort. See **Plumbago.**



Leaves, the chief food-making parts of plants, vary greatly in appearance. Most plants have broad, flat leaves, such as those of a maple tree, *left.* But oats, *centre,* and other grasses have long, narrow leaves. Pines, *right,* and most other cone-bearing plants have needle leaves.

Leaf

Leaf is the main food-making part of almost all plants. Garden flowers, grasses, shrubs, and trees depend on their leaves to make food for the rest of the plant. So do ferns, vegetables, vines, weeds, and many other plants.

Leaves work like tiny food factories. They capture energy from sunlight and use it to make food out of water from the soil and *carbon dioxide,* a gas in the air. This food provides plants with energy to grow, to produce flowers and seeds, and to carry on all their other activities. Plants store the food made by leaves in their fruits, roots, seeds, and stems and even in the leaves themselves. Without this food, plants could not live. In addition, all the food that people and animals eat comes either from plants or from animals that eat plants.

Leaves vary tremendously in appearance. Some are round, and others oval. Still others are shaped like arrowheads, feathers, hands, hearts, or any number of other objects. However, most leaves can be divided into three groups according to their basic shape. (1) *Broad leaves* are the type of leaf that most plants have. These leaves are fairly wide and flat. Plants that have such leaves include oak and sycamore trees, pea plants, and rosebushes. (2) *Narrow leaves* are long and slender. Such leaves grow on grasses. Grasses include not only lawn grasses but also maize, oats, wheat, and other cereal grasses. Lilies, onions, and certain other plants also have narrow leaves. (3) *Needle leaves* grow on firs, pines, spruces, and most other cone-bearing trees and shrubs. Such leaves resemble short, thick sewing needles. A few other kinds of cone-bearing plants, including certain cedars and junipers, have scalelike leaves.

Most leaves grow 2.5 to 30 centimetres long. Some plants, however, have huge leaves. The largest leaves grow on the African raffia palm. The leaves of this tree measure up to 20 metres long. The giant water lily of South America has round, floating leaves up to 1.8 metres across. In contrast, some plants have extremely small leaves. The true leaves of asparagus plants, for example, are so tiny that they are hard to see without a magnifying glass. In these plants, the stems, not the leaves, produce food.

The number of leaves on plants ranges from several to thousands. Most soft-stemmed plants have few leaves. For instance, a barley or wheat plant produces only 8 to 10 leaves each season. But trees may have an enormous number of leaves.

Some simple plants that manufacture their own food do not have leaves. For example, liverworts and mosses are simple food-making plants that lack true leaves. In some of these simple plants, however, the green food-making tissues look like tiny leaves.

The importance of leaves

The chief job of leaves is to make food for plants. This food-making activity, called *photosynthesis,* occurs in fully grown leaves. But young leaves also are important. They wrap tightly around the tips of growing stems. They thus keep the delicate tips moist and help protect them from insects, cold, and other dangers.

Leaves are also vital to animals. Animals cannot make their own food. They depend on plants for their basic supply of food. Many animals eat leaves. For example, antelope, sheep, and other grazing animals eat grass leaves. People also eat leaves, such as those of cabbage, lettuce, and spinach plants. But even when people and animals eat the fruits, roots, seeds, and stems of plants, they are obtaining food made by leaves. In the same way, eggs, meat, milk, and all other animal foods can be traced back to food made by photosynthesis.

Leaves help make the air breathable. They release oxygen during photosynthesis. People and animals must have oxygen to live. Without the activities of leaves, the earth's supply of breathable oxygen would probably soon be used up.

People obtain many products from leaves in addition to food. For instance, we use the leaves of the tea plant to make tea. Peppermint and spearmint leaves contain oils used to flavour sweets and chewing gum. Such leaves as bay, sage, and thyme are used in cooking to flavour foods. Some drugs come from leaves. For example, the drug digitalis, which is used to treat certain heart diseases, comes from the leaves of the purple foxglove, a common garden flower. Leaves of abacá and sisalana plants provide fibre used in making rope. Finally, the leaves of the tobacco plant are used to make cigarettes, cigars, and other tobacco products.

The life story of a leaf

A leaf begins its life in a bud. Buds are the growing areas of a stem. They form along the sides of the stem, at the point just above where a fully grown leaf is attached. A bud also grows at the tip of the stem. A leaf bud contains undeveloped leaf and stem tissues. Within the bud is a mound slightly larger than the head of a pin. Each leaf starts out as a tiny bump on the side of this mound. The mature bud contains a tightly packed group of tiny leaves.

In most soft-stemmed plants, the buds are hard to see. A new leaf becomes noticeable only after it begins to unfold. Most soft-stemmed plants continue to form new leaves until the plants flower or until cold weather sets in. In *temperate regions,* which have warm summers and cold winters, the aboveground parts of many soft-stemmed plants die after the first hard frost, but the roots live through the winter. Other soft-stemmed plants die completely after the cold weather arrives.

Woody plants, on the other hand, may live many years. They grow several sets of leaves during their lifetime. Most needleleaf trees and shrubs shed old leaves and grow new ones continuously throughout the year. So do most broadleaf trees in the tropics. But in temperate regions, most broadleaf trees and shrubs are *deciduous.* Deciduous plants of temperate regions shed their leaves in autumn and grow a new set each spring.

Deciduous trees and shrubs start growing the next year's leaves even before the present year's leaves have fallen. The new leaves are enclosed in *winter buds.* The leaves in the winter buds stop growing during the summer and remain *dormant* (inactive) throughout the winter. During the winter months, the buds are protected from drying out by special outer leaves called *bud scales.* In spring, warmth and moisture cause the dormant leaves to become active. The bud scales drop off, and the leaves unfold.

The leaf becomes fully grown. Leaves complete their growth within one week to several weeks, depending on the kinds of plants that produce them. At first, the unfolding leaf must get all its food from older leaves or from food stored by the plant. Soon, however, the young leaf turns a deeper green and begins to make its own food. Gradually, the leaf produces extra food, which is sent to the rest of the plant.

During the growing season, the colour of the leaf changes from bright green to a duller green. The leaf also becomes tougher because its cells develop thicker walls. During this time, a special change occurs in the leaves of deciduous trees and shrubs. A corky layer of cells known as the *abscission zone* develops where the stalk of the leaf joins the stem. This zone breaks down in autumn, causing the leaf to separate from the stem.

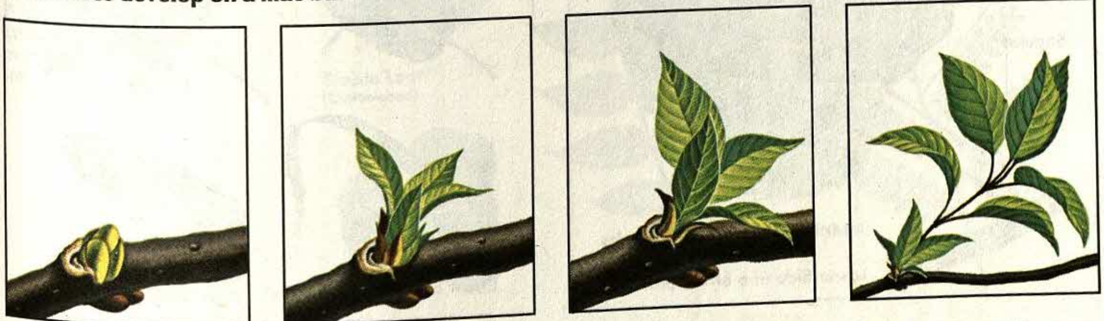
The leaf changes colour. The leaf is green because it contains a green *pigment* (colouring matter) called *chlorophyll.* This pigment plays a major role in photosynthesis. The leaf also has other colours, but they are hidden by the chlorophyll. As autumn approaches, however, the shorter days and cooler nights cause the chlorophyll in deciduous broad leaves to break down.

The hidden colours of the leaf appear as the chlorophyll breaks down. The leaf may then show the yellow colour of the pigment *xanthophyll* or the orange-red tones of the *carotene* pigments. In addition, a group of red and purple pigments called *anthocyanins* forms in the dying leaf. The colour of the autumn leaf depends on which of the pigments is most plentiful in the leaf.

The leaf dies. After the chlorophyll breaks down, the leaf can no longer make food. The tiny pipelines between the leaf and the stem become plugged. These pipelines carried water to the leaf and food from it. The cells in the abscission zone separate or dissolve, and the dying leaf hangs from the stem by only a few strands. These strands dry and twist in the wind. When the strands break, the dead leaf floats to the ground.

After the leaf falls, a mark remains on the twig where

How leaves develop on a lilac bush



Leaves form inside a bud. The *winter bud* above protects tiny leaves in winter.

The bud opens in spring as warmth and moisture cause the bud scales to fall off.

The young leaves unfold. As they turn a darker green, they begin to make food.

A twig develops with many young leaves several weeks after the bud has opened.

Leaf edges

The blades of broadleaf plants have three chief types of edges: (1) smooth, (2) toothed, and (3) lobed. Smooth-edged leaves are most common on plants native to warm climates. Many temperate broadleaf plants have jagged, toothed blades. Other temperate species have lobed blades, which look as if large bites were taken out of them.

Smooth-edged leaf blade
(Rubber plant)

Toothed leaf blade
(Birch)

Lobed leaf blade
(Oak)

the leafstalk had been attached. This mark is called a *leaf scar.* The broken ends of the water and food pipelines can be seen within the leaf scar.

On the ground, the dead leaf becomes food for bacteria and fungi. They break the leaf down into simple substances, which then sink into the soil. There, these substances will be absorbed by plant roots and provide nourishment for new plant growth.

The parts of a leaf

Most leaves have two main parts: (1) the blade and (2) the petiole, or leafstalk. The leaves of some kinds of plants also have a third part, called the *stipules.*

The blade, or *lamina,* is the broad, flat part of the leaf. Photosynthesis occurs in the blade, which has many green food-making cells. Leaf blades differ from one another in several ways. The chief differences are in: (1) the types of edges, (2) the patterns of the veins, and (3) the number of blades per leaf.

The types of edges. Almost all narrow, grasslike leaves and needle leaves have a blade with a smooth edge. But the edge of broadleaf blades varies greatly among the different types of plants.

Many broadleaf plants, particularly those that are native to warm climates, have smooth-edged leaf blades. The rubber plant, a common house plant, is a good example of such a plant.

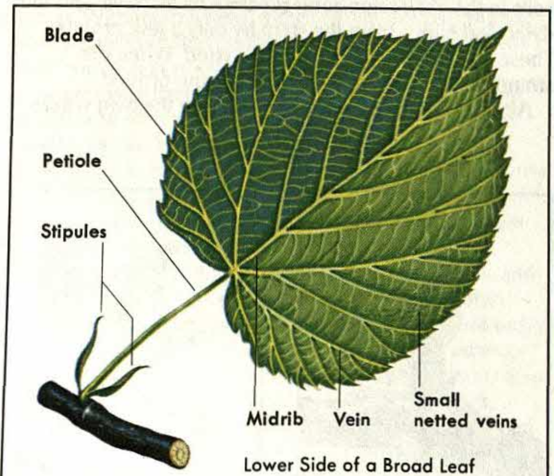
The leaves of many temperate broadleaf plants have small, jagged points called *teeth* along the blade edge. Birch and beech trees have such leaves. In many plants, the teeth contain *hydathodes,* tiny valvelike structures that can release excess water from the leaf. The teeth of young leaves on many plants, including some cherry and poplar trees, bear tiny glands. These glands produce liquids that repel planteating insects.

Some temperate broadleaf plants—including fig trees and certain mulberry and oak trees—have *lobed* leaves. The edge of such a leaf looks as if large bites have been taken out of it. The lobing helps heat escape from the leaf.

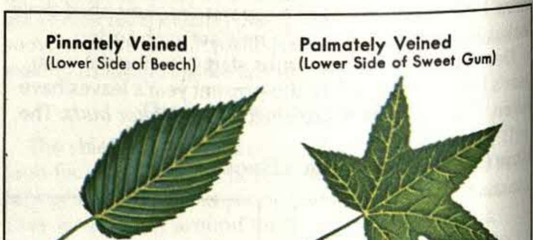
The patterns of the veins. Veins are pipelines that carry food and water in a leaf. If you hold a leaf blade up to light, you can see the pattern of its veins.

In most broad leaves, the veins form a netlike pattern, with several large veins connected by many smaller ones. The smallest veins supply every part of the blade with water. They also collect the food made by the green cells.

There are two main types of net-vein patterns—*pinnate* (featherlike) and *palmate* (palmlike or handlike). Pin-



The parts of a leaf. Most leaves have two main parts: (1) a flat *blade* and (2) a stemlike *petiole.* The leaves of many plants also have a third main part, two small flaps called the *stipules.*



Vein patterns differ among leaves. Most broad leaves have a *pinnate* (featherlike) or *palmate* (palmlike) vein pattern. Grasses have parallel veins. Needle leaves have one or two centre veins.

nately net-veined leaves have one large central vein, called the *midrib,* which extends from the base of the blade to its tip. Other large veins branch off on each side of the midrib. The leaves of beech, birch, and elm trees have such a vein pattern. A palmately net-veined leaf has several main veins of about equal size, all of which extend from a common point at the base of the blade. The vein patterns of maple and sycamore leaves are palmate.

Narrow leaves and needle leaves are not net-veined. Narrow leaves have a parallel-vein pattern. Several large veins run alongside one another from the base of the blade to the tip. Small crossveins connect the large veins. Needle leaves are so small that they have only one or two veins. These veins run through the centre of the blade.

Leaf veins do more than carry water and food. They also support the blade, much as the metal ribs support the fabric of an open umbrella. The veins are tougher and stronger than the green tissue around them. They help the leaf keep its shape and prevent it from collapsing or tearing.

The number of blades per leaf. A leaf may have one or more blades. A leaf that has only one blade is called a *simple leaf.* Apple and oak trees, grasses, and many other kinds of plants have simple leaves. A leaf that has more than one blade is known as a *compound leaf.* The blades of a compound leaf are called *leaflets.*

The leaflets in a compound leaf may be arranged in a pinnate or palmate pattern. In pinnately compound leaves, the leaflets grow in two rows, one on each side of a central stalk, called the *rachis.* Plants with pinnately compound leaves include ash and walnut trees and garden peas. The leaflets in a palmately compound leaf all grow from the tip of the leafstalk. Clover, horse chestnut trees, and many other plants have palmately compound leaves.

A few plants—including carrots, and some mimosas—have *double compound leaves.* In double compound leaves, each leaflet is divided into a number of still smaller leaflets. One double compound leaf, for example, looks more like a group of twigs and leaves than like a single leaf.

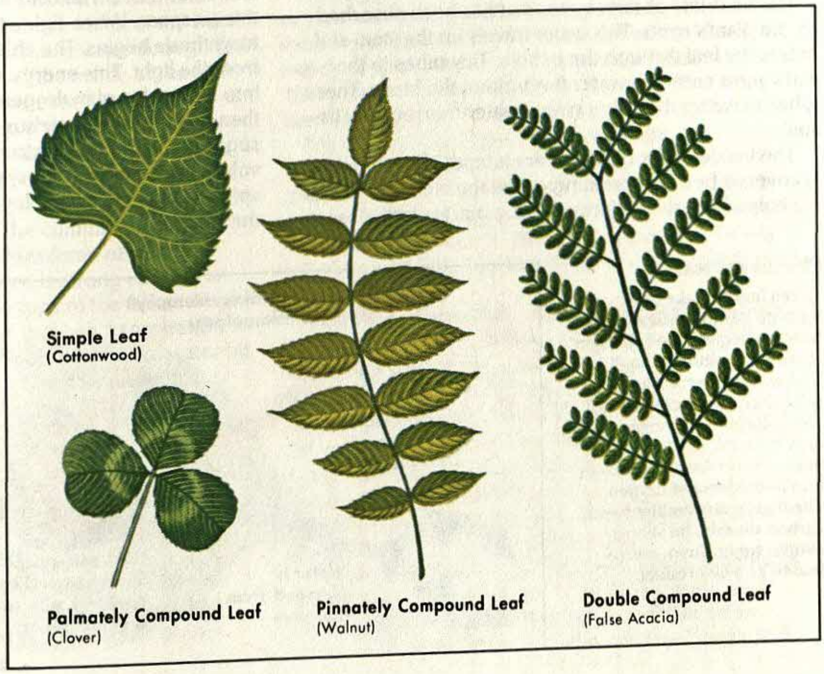
The petiole is the stemlike part of the leaf. It joins the blade to the stem. Within a petiole are tiny tubes, bound together tightly like a bundle of drinking straws. These tubes connect with the veins in the blade. Some of the tubes carry water into the leaf. Others carry away food that the leaf has made.

The leaves of many plants have petioles that grow extra long if the blades are shaded. For example, white clover plants growing among unmowed grass may have petioles up 15 centimetres long. These long petioles lift the clover leaflets into the sunlight. In a lawn where the grass is kept short, the clover petioles may measure less than 2.5 centimetres long.

In many trees and shrubs, the petioles bend in such a way that the blades receive the most sunlight. As a result of this bending, few of the leaves are shaded by other leaves. The petiole also provides a flexible "handle" that enables the blade to twist in the wind and so avoid damage.

In some plants, the petioles are much larger than the stems to which they are attached. For example, the parts we eat of celery and rhubarb plants are petioles. In contrast, the leaves of some soft-stemmed plants, particularly grasses, have no petioles.

The stipules are two small flaps that grow at the base of the petiole of some plants. Many stipules look like tiny green leaf blades. In some plants, the stipules grow quickly, enclosing and protecting the young blade as it develops. Some stipules, such as those of willows and certain cherry trees, produce substances that prevent insects from attacking the developing leaf.



Simple and compound leaves

A leaf may have one or more blades. If a leaf has only one blade, it is called a *simple leaf.* A leaf with more than one blade is known as a *compound leaf.* The blades of a compound leaf are called *leaflets.* They may be arranged in a palmate or pinnate pattern. A few plants have *double compound leaves,* in which each leaflet is further divided into still smaller leaflets.

In many plants, the stipules drop off after the blade has developed. But garden peas and a few other kinds of plants have large stipules that persist and become an extra food-producing part of the leaf.

How a leaf makes food

A green leaf is a marvelous food-making factory. Using only the energy of the sun, it takes simple materials and turns them into energy-rich food. This section describes how a leaf obtains the raw materials needed to make food. It then provides a simple explanation of how the leaf produces food through photosynthesis. Finally, this section discusses *transpiration,* a process of water loss that plays a key role in the operation of the leaf food factory.

Obtaining the raw materials. A leaf needs three things to make food. They are (1) carbon dioxide, (2) water, and (3) light. The carbon dioxide and water serve as the raw materials of photosynthesis. The light, which is normally sunlight, provides the energy that powers photosynthesis.

Carbon dioxide enters a leaf from the air. The *epidermis* (outer surface) of the leaf has many tiny pores. These openings, called *stomata,* enable carbon dioxide to enter the leaf. Each pore is surrounded by two curved, bean-shaped *guard cells* that can swell and relax. When they swell, the pore is opened wide, and carbon dioxide enters the leaf. When the guard cells relax, the pore closes. In most plants, the stomata open during the day and close at night.

A leaf has many stomata. For example, a sunflower leaf may have nearly 2 million stomata. However, the pores are so small that they make up less than 1 per cent of the leaf's surface. In most plants that grow in full sun, the majority of the stomata are in the shaded lower epidermis of the leaves. In many other plants, the stomata are about equally divided between the upper and lower epidermis.

Water. A leaf obtains water that has been absorbed by the plant's roots. This water travels up the stem and enters the leaf through the petiole. Tiny tubes in the leaf's veins carry the water throughout the blade. These tubes make up the vein's *xylem* (water-transporting tissue).

The inside of the blade is very humid. The epidermis is covered by a waxy coating called the *cuticle.* The cuticle helps keep the leaf from drying out. Nevertheless, a leaf does lose much water. Most of this water escapes as vapour through the stomata by the process of transpiration.

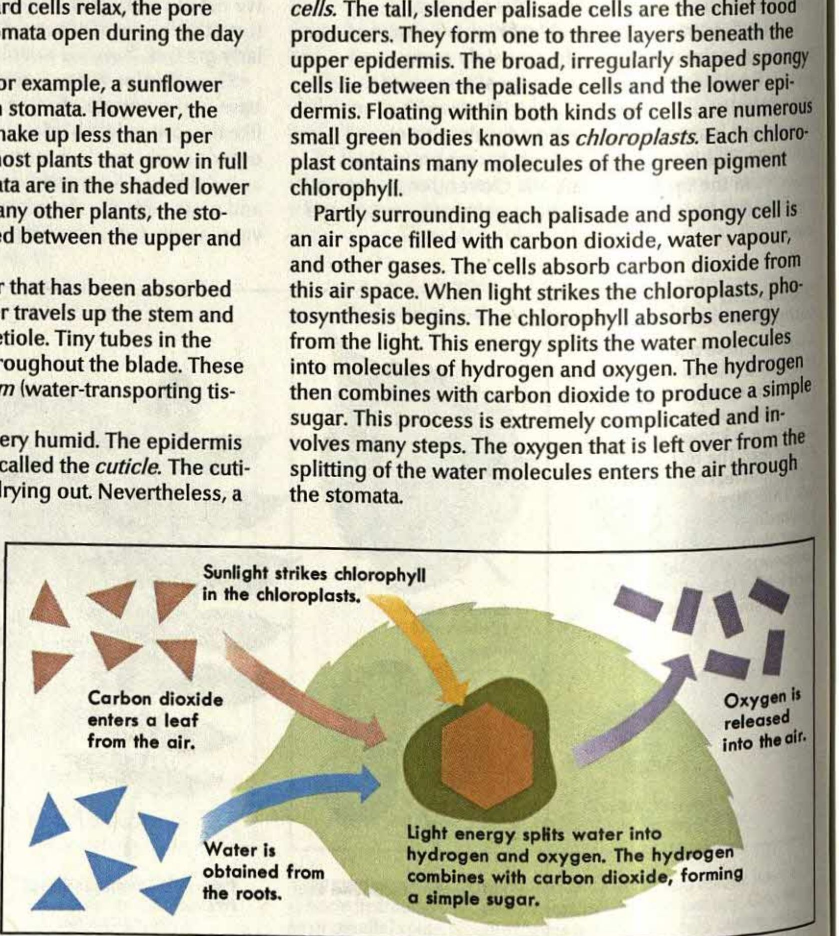
Light. Leaves cannot make food without light. But most leaves work best when the sunlight is at a certain level of brightness. If the light is too dim, the leaf will not make enough food. But if the light is too bright, it can damage the food-making cells.

The leaves of many plants that grow in bright sunlight have an extremely thick cuticle, which helps filter out strong light and guards against excess water loss. The leaves may also have many hairs growing out of the epidermis. The hairs further reduce the intensity of bright light. The leaves of such plants as geraniums and white poplar trees have so many epidermal hairs that they feel fuzzy. Certain *alpine* plants (plants that grow at high altitudes) also have coatings of white hairs which serve the same purpose, and also help to insulate the plant against the extremely cold winds and low night temperatures of alpine regions.

Some plants, including the herbs, ferns, and shrubs of the forest floor, thrive in shade. The leaves of most of these plants have a thin cuticle and few epidermal hairs. These features allow as much of the dim light as possible to enter the leaves.

Photosynthesis occurs inside the leaf blade in two kinds of food-making cells—*palisade cells* and *spongy cells.* The tall, slender palisade cells are the chief food producers. They form one to three layers beneath the upper epidermis. The broad, irregularly shaped spongy cells lie between the palisade cells and the lower epidermis. Floating within both kinds of cells are numerous small green bodies known as *chloroplasts.* Each chloroplast contains many molecules of the green pigment chlorophyll.

Partly surrounding each palisade and spongy cell is an air space filled with carbon dioxide, water vapour, and other gases. The cells absorb carbon dioxide from this air space. When light strikes the chloroplasts, photosynthesis begins. The chlorophyll absorbs energy from the light. This energy splits the water molecules into molecules of hydrogen and oxygen. The hydrogen then combines with carbon dioxide to produce a simple sugar. This process is extremely complicated and involves many steps. The oxygen that is left over from the splitting of the water molecules enters the air through the stomata.

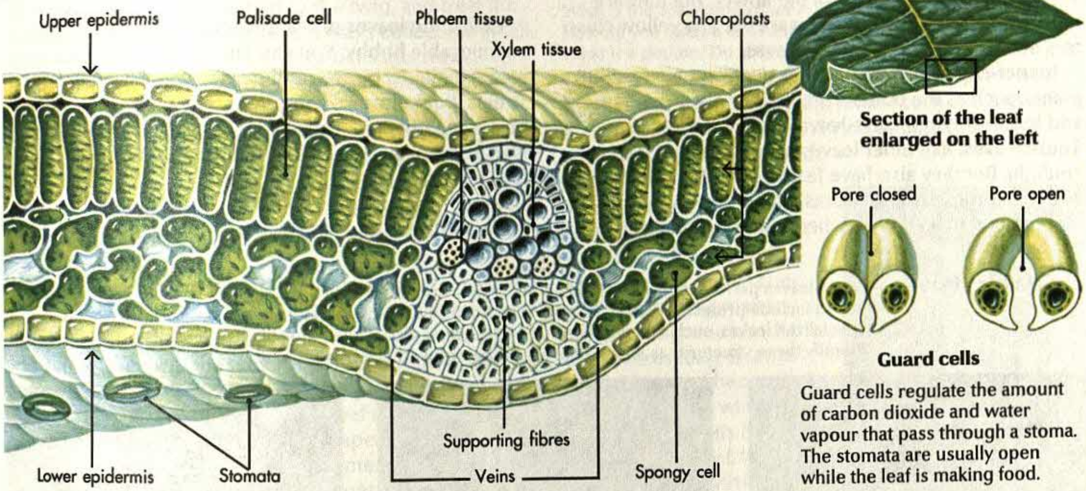

Sunlight strikes chlorophyll in the chloroplasts.
Carbon dioxide enters a leaf from the air.
Oxygen is released into the air.
Water is obtained from the roots.
Light energy splits water into hydrogen and oxygen. The hydrogen combines with carbon dioxide, forming a simple sugar.

Photosynthesis

Green leaves make food through *photosynthesis.* This process begins when sunlight strikes *chloroplasts,* small bodies that contain a green substance called *chlorophyll.* The chlorophyll absorbs energy from the sunlight. This energy splits water molecules into hydrogen and oxygen. The hydrogen combines with carbon dioxide, forming a simple sugar. Oxygen is released as a by-product.

Inside a typical green leaf

This cross section shows a typical simple leaf blade. Palisade and spongy cells serve as food producers. In the veins, xylem tissue distributes water, and phloem tissue carries away food. *Stomata* (pores) on the underside of the blade enable gases to enter and leave the leaf.



Guard cells

Guard cells regulate the amount of carbon dioxide and water vapour that pass through a stoma. The stomata are usually open while the leaf is making food.

The sugar produced by photosynthesis is carried in special tubelike cells that make up the vein's *phloem* (food-transporting tissue). The sugar moves through the petiole to the stem and all other parts of the plant. In the plant cells, the sugar may be burned and thus release energy for growth or other activities. Or the sugar may be chemically altered and form fats and starches. In addition, the sugar may be combined with various minerals, and so produce proteins, vitamins, and other vital substances. The minerals enter the plant dissolved in the water absorbed by the roots.

Transpiration occurs as the sun warms the water inside the blade. The warming changes much of the water into water vapour. This gas can then escape through the stomata. Transpiration helps cool the inside of the leaf because the escaping vapour has absorbed heat.

Transpiration also helps keep water flowing up from the roots. Water forms a continuous column as it flows through the roots, up the stem, and into the leaves. The molecules of water in this column stick to one another. As the molecules at the top of the column are lost through transpiration, the entire column of water is pulled upward. This pulling force is strong enough to draw water and minerals to the tops of the tallest trees.

A plant may lose much water through transpiration. A maize plant, for example, loses about 4 litres of water on a hot day. If the roots cannot replace this water, the leaves wilt and photosynthesis stops.

Specialized leaves

Some leaves have special functions along with or instead of food making. Such specialized leaves include (1) protective leaves, (2) storage leaves, (3) tendrils, (4) bracts, and (5) insect-capturing leaves.

Protective leaves include bud scales and spines. Bud scales are short and broad, and they overlap like roof shingles. In many plants, the bud scales have an outer layer of waterproof cells.

Spines are sharp leaf structures that protect the plant from being eaten. For instance, spines cover the leaves of thistles, protecting the plant from grazing animals. Holly, an evergreen shrub or tree, has spines along the edges of the leaves. Many cactuses have clusters of spines. In many species of cactuses, the pointed spines replace the leaves on the mature plants. In these plants, the green stem has the job of photosynthesis.

Another type of protective leaf is the *spathe,* found in members of the arum family. The spathe is rolled lengthwise and protects the flowers inside.

Storage leaves. Most plants store food in their roots or stems. But some plants have special leaves that hold extra food. Onion and tulip bulbs, for example, consist mainly of short, fat storage leaves called *bulb scales.* These leaves cannot make food. Their job is to store food underground during the winter. See **Bulb.**

Many plants that grow in dry places have thick leaves that store water. The mosslike stonecrop plants that grow on rocky cliffs have such leaves. The traveller's-tree, which grows in Madagascar, has enormous leaves that hold much water in their hollow petioles. Thirsty travellers can obtain a drink by punching a hole in the base of a petiole.

Tendrils are slender, whiplike structures that help hold climbing plants in place. They wrap around twigs, wires, and other solid objects. Among many climbing plants, specialized leaves serve as tendrils. For example, climbing garden peas have compound leaves in which the upper leaflets are threadlike tendrils. In one kind of sweet pea, a garden flower, the entire leaf blade becomes a tendril. The plant's stipules enlarge and take over the food-making job. The passion flower is another plant that climbs by means of tendrils.

Bracts grow just below the flowers of certain plants. Most bracts are smaller and simpler in shape than a plant's regular leaves. Many members of the daisy family—including daisies, goldenrods, marigolds, and sunflowers—have bracts. These bracts form a cup beneath the plant's cluster of flowers.

A few kinds of plants, such as bougainvillea, flowering dogwood and poinsettia, have large, showy bracts. These bracts look like part of the flower, but they are not. The true dogwood flowers are the tiny yellow clusters in the centre of the white leaves.

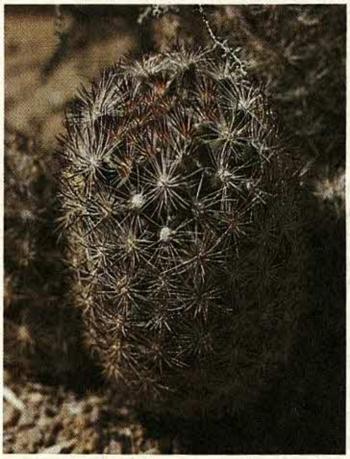
Insect-capturing leaves. *Carnivorous* (meat-eating) plants, such as the butterwort, pitcher plant, sundew, and Venus's-flytrap, have leaves that capture insects. These leaves, like other leaves, can make food using sunlight. But they also have features that attract, trap, and then digest insects. Plants with insect-capturing leaves grow in wetlands, where the soil contains little nitrogen. They obtain this necessary nutrient from the captured insects. For a description of these plants and their leaves, see the article **Carnivorous plant.**

How to collect leaves

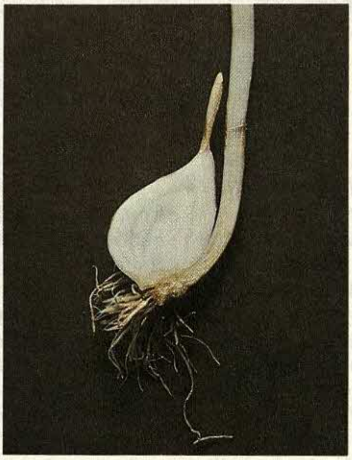
Collecting leaves or leaf rubbings and prints can be an enjoyable hobby. You can find plants with interesting leaves in fields, forests, and gardens and even along city streets. But before you remove any leaves from a plant, be sure to obtain permission from the owner of the land. In many parks and other public lands, it is illegal to take leaves.

When you collect large leaves, remove only a few. Always pick a complete leaf, including the petiole. In most

Specialized leaves Some leaves perform special tasks in addition to or instead of food making. Such specialized leaves include protective leaves, storage leaves, tendrils, bracts, and insect-capturing leaves. Some specialized leaves, such as the spines of a cactus plant, do not even look like leaves. Botanists identify these structures as leaves because of their growth patterns.

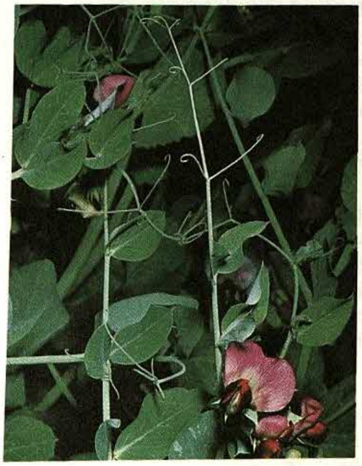


Protective leaves include spines like those on the hedgehog cactus above. They keep animals from eating the plant.

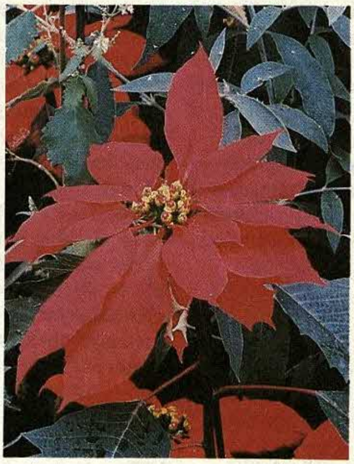


Food storage leaves include the bulb scales of a tulip, *above.* These fat leaves store food underground in winter.

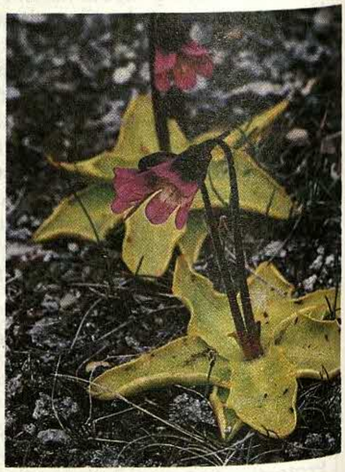
Water storage leaves are common on plants that grow in dry regions. Such plants include the stonecrop, *above.*



Tendrils hold climbing plants in place. The tendrils of the garden pea plant above are wrapped around wires.



Bright red bracts surround the flowers of the poinsettia above. These leaves help attract pollinating insects to the flowers.



Insect-capturing leaves attract, trap, and digest insects. Butterwort leaves, *above,* trap their prey in a sticky film.

leaves, the petiole will separate easily from the stem. If you are collecting compound leaves, remember to keep all the leaflets attached to the long petiole. When you collect small leaves, you may need to cut off part of a twig. Keep the leaves attached to the twig, and treat the cutting as if it were a single leaf. Always collect the small needle leaves of firs, pines, and spruces this way.

How to preserve leaves. Freshly cut leaves will curl and crack unless you press them. To press leaves, arrange them between several sheets of newspaper. Then place a weight on the newspapers. A piece of plywood with books stacked on it makes a good weight. After a week of pressing, the leaves should remain flat. You can then mount them on stiff paper by placing a strip of tape across the petiole.

How to make leaf rubbings and prints. To make a leaf rubbing, lay the leaf lower-side up on a tabletop. Cover the leaf with a sheet of tracing paper or thin typing paper. Then rub the paper lightly and rapidly with the side of a sharpened soft pencil, a piece of charcoal, or a wax crayon. The outline of the leaf and the larger veins will gradually appear on the paper.

To make a leaf print, you need printer's or etcher's ink and a roller. These materials can be obtained at an art supply shop. Use the roller to spread a thin layer of ink on a glass plate or a smooth piece of cardboard. Next lay the leaf lower-side down on the ink. Then place a piece of paper over the leaf and rub the entire leaf with your fingers. After rubbing, remove the paper and carefully pick up the leaf. Place the leaf's inky surface on a sheet of plain paper. Now cover the leaf with another sheet of paper and rub. Be careful not to move the leaf as you rub. After rubbing the leaf, remove the top sheet of paper and the leaf. A print of the leaf will appear on the lower sheet.

Related articles. Many ***World Book*** articles on individual plants contain information about leaves. For example, see **Ivy; Maple; Palm; Poinsettia.** For illustrations of the leaves of many common trees, see **Tree.** Other related articles include:

Bud
Chlorophyll
Photosynthesis
Plant

Outline

I. The importance of leaves
II. The life story of a leaf
  A. A leaf begins its life
  B. The leaf becomes fully grown
  C. The leaf changes colour
  D. The leaf dies
III. The parts of a leaf
  A. The blade
  B. The petiole
  C. The stipules
IV. How a leaf makes food
  A. Obtaining the raw materials
  B. Photosynthesis
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V. Specialized leaves
  A. Protective leaves
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  D. Bracts
  E. Insect-capturing leaves
VI. How to collect leaves
  A. How to preserve leaves
  B. How to make leaf rubbings and prints

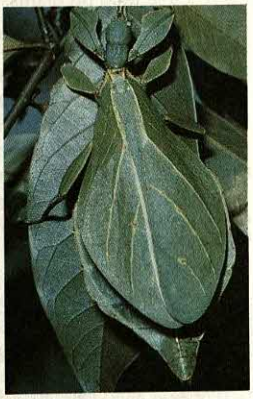
Questions

Why do deciduous broad leaves change colour as autumn approaches?
What is *transpiration*?
Why are leaves vital to plants and animals?
How do carnivorous plants obtain nitrogen?
How do simple and compound leaves differ?
What are some products that come from leaves?
How does a leaf obtain carbon dioxide?
What is the *abscission zone?* A *leaf scar?*
How do you make a leaf rubbing?
What is a *petiole?* Do all leaves have one?

Leaf-cutter ant. See **Ant** (Fungus growers).

Leaf insect is an insect that looks much like a green leaf or a twig. It is found in Africa, southeastern Asia, and northern Australia, and on the many islands of the South Pacific. Stick insects are closely related species.

The best-known leaf insect is an East Indian species. It is bright green in colour and grows about 8 centimetres long. It looks much like a leaf because of its broad ribbed wings, which fold over its back in the shape of a leaf. It also has leaflike growths on the joints of the legs. The eggs look like the seeds of plants. Leaf insects live among the leaves of trees and shrubs, where they are hard to find because of their shape and colour. They feed on leaves at night and usually stay quiet during the day.

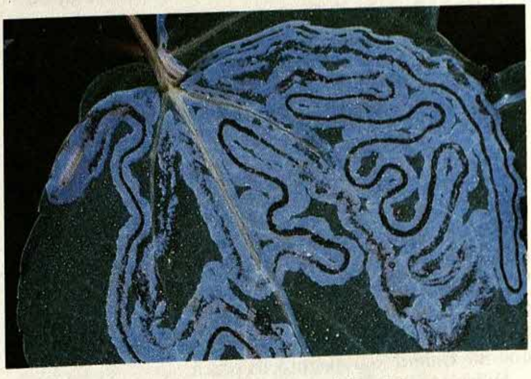


Leaf insect

Scientific classification. The East Indian leaf insect belongs to the stick insect family, Phasmidae. Some scientists classify leaf insects in the order Orthoptera. Others put them in the order Phasmida.

See also **Stick insect.**

Leaf miner is a tiny beetle, moth, fly, or wasp which, in the larval stage, tunnels between the upper and lower surfaces of leaves. The leaves provide food and protection for the larvae. Leaf miners can often be identified by the shape of the whitish tunnels or blotches they make in leaves and by the plant species they infest. Some leaf miners migrate from leaf to leaf. Others tunnel in the stems, roots, or fruits of plants, or feed on the outer surface of leaves. A few species occur in great enough numbers to be very destructive. See **Larva.**



Leaf miner larvae eat tunnels through leaves.

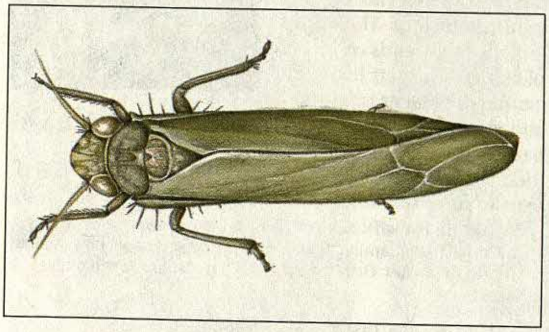
The lives of leaf miners begin when female insects lay eggs on leaves. The larvae that hatch from these eggs begin to eat tunnels, or mines, in the leaves. The larvae take from one to three weeks to nearly a year to mature. They then enter the pupal stage of their lives (see **Insect** [The life cycle of insects]). There are many species of leaf miners and they are found throughout the world.

Scientific classification. Leaf miners belong to the orders Coleoptera, Diptera, Hymenoptera, and Lepidoptera.

Leaf-monkey. See **Colobus; Langur.**

Leafhopper is one of a large group of small, slender insects that feed on plants. These insects are found throughout the world. All species have piercing-sucking mouth parts. They rob plants of their juices, causing them to dry up and wilt. They run sideways, and the winged species fly easily. Many carry plant diseases. Leafhoppers may be brightly coloured, or dull brown or green. Most are small, averaging 0.5 centimetres long, but some tropical species are over 1 centimetre long.

Scientific classification. Leafhoppers belong to the order Homoptera and the leafhopper family, Cicadellidae. The apple leafhopper is *Empoasca mali.*



The leafhopper destroys plants by sucking out juices. Many leafhoppers also harm vegetation by carrying plant diseases.

League is a measure of length. A *statute league* equals 3 statute, or land, miles. It also equals 15,840 feet, or 4.828 kilometres. A *nautical league* equals 3 nautical or sea miles. It also equals 18,228.346 feet, or 5.555963 kilometres. The word *league* is sometimes used by British and American sailors. The league has been used since ancient times. The Gauls made the league equal to 1,500 Roman paces, or what would be 1.376 modern English miles (2.2 kilometres). The Normans brought the league to England. At that time the league equalled 2 English miles, or 2.9 modern statute miles (4.7 kilometres).

See also **Mile.**

League of Nations was an international association of countries created to maintain peace among the nations of the world. The victors of World War I—including France, Great Britain, Italy, Japan, and the United States—drew up a *covenant* (constitution) for the League in 1919. The League was established in January 1920, with headquarters in Geneva, Switzerland. President Woodrow Wilson of the United States was the chief planner of the League, but he could not persuade the U.S. to join it. The League was dissolved in April 1946, and the United Nations took its place.

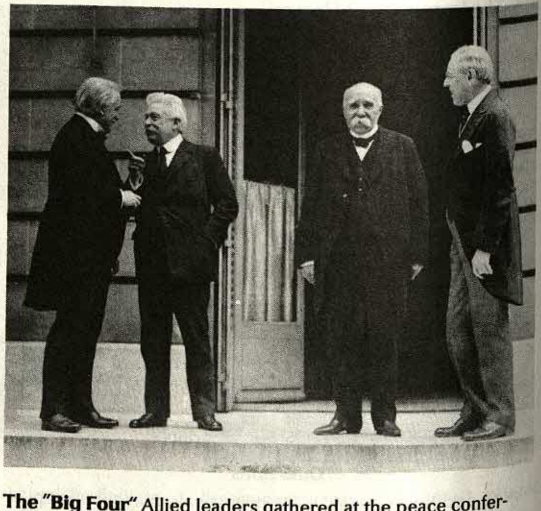
Wilson believed that world wars would continue to occur as long as each nation had to be responsible for its own defence. Under this condition, nations would form competing groups, each arming against the other. Wilson wanted the nations of the world to join together in the League of Nations, and pledge to defend the territory and independence of any member attacked by another nation. He believed that even a powerful nation, knowing it would face the united opposition of all other powerful nations, would not go to war.

Wilson got other countries to agree to his plans for the League, but he and members of the U.S. Senate differed over the terms on which the United States would join. In March 1920, the U.S. Senate rejected the treaty which would have made the United States a member. Within a few years, most Americans decided there was no need to concern themselves with conflicts overseas, and the United States never did join the League of Nations.

Powers and organization

The League Covenant contained articles pledging member nations to preserve the independence and territory of all members against attack. Members agreed to submit any disputes that might lead to war either to *arbitration* (decision by a third party) or to an investigation by the League Council. They promised not to go to war with any member that agreed to the recommendations of a court of arbitration or the League Council. If any member went to war in violation of these articles, member nations agreed they would apply economic *sanctions* (penalties), such as stopping trade with the offending nation. At the League Council's request, they would also use military force against that nation.

The Council was the principal peacekeeping agency. Its size varied from 8 to 14 members during the League's history. The most powerful members of the League had permanent seats on the Council. France, Germany, Great Britain, Italy, Japan, and the Soviet Union held permanent seats during the years they were members of the League. The remaining seats were rotated among the small nations of the League.



The "Big Four" Allied leaders gathered at the peace conference. *Left to right* are David Lloyd George of Britain, Vittorio Orlando of Italy, Georges Clemenceau of France, and Wilson.

The Palace of Nations in Geneva, Switzerland, was the headquarters of the League of Nations until the League was dissolved in 1946. The *Sphere of Nations* stands in the foreground.

The Assembly was composed of all member nations, and each member had one vote. The Assembly controlled the League budget, admitted new members, elected the temporary Council members, and made amendments to the Covenant. On these matters, the Assembly could decide by a two-thirds or a majority vote.

The Secretariat provided the administrative staff of the League. A secretary-general, who was nominated by the Council and approved by the Assembly, headed a staff of about 600 officials. These officials assisted the peacekeeping work of the League and provided personnel for special study commissions on disarmament and colonial affairs. The Secretariat also staffed the various international organizations set up by the League to promote cooperation in international trade, finance, transportation, communication, health, and science.

The League in action

Wilson and the other statesmen who designed the League hoped it would lead nations to stop seeking protection through special alliances. Instead, they favoured a system of *collective security,* in which the security of each member would be guaranteed by the protection of all. For collective security to work, it was essential that all League members—especially the most powerful ones—come to the aid of any member attacked.

Neither the Council nor the Assembly could force members to help an attacked nation. This action had to be voluntary. Each member nation had to believe that a threat to the peace of any nation—even a small, distant nation—was a threat to its own peace.

Disagreement among members. The most powerful nations did not agree that collective security was the main purpose of the League. France saw the League mainly as an instrument to maintain the territorial settlement imposed on Germany after World War I. The Germans resented the League because it seemed to them, too, that this was the League's real purpose. British leaders considered it a meeting place for powerful nations to consult in the event of a threat to peace. But they did not want to commit themselves in advance to do anything as a result of such talks. The Soviet Union believed the League was an imperialist fraud, because Communism taught that war was inevitable among capitalist nations. Japan and Italy showed their disregard for collective security by attacking member nations.

The League of Nations

The following nations were the original members of the League. Many other nations joined later, and many withdrew from the League before it was disbanded in April 1946.

Argentina
Australia
Belgium
Bolivia
Brazil
Canada
Chile
China
Colombia
Cuba
Czechoslovakia
Denmark
El Salvador
France
Great Britain
Greece
Guatemala
Haiti
Honduras
India
Iran
Italy
Japan
Liberia
Netherlands
New Zealand
Nicaragua
Norway
Panama
Paraguay
Peru
Poland
Portugal
Romania
South Africa
Spain
Sweden
Switzerland
Thailand
Uruguay
Venezuela
Yugoslavia

Japan withdrew from the League in 1933 because the League refused to recognize its conquest of Manchuria. Germany, admitted to the League in 1926, withdrew in 1933 because the League would not change the arms limitations imposed on Germany after World War I. Italy withdrew from the League in 1937 to join Japan and Germany in an alliance against the Soviet Union. The Soviet Union, which joined the League in 1934, was expelled in 1939 for attacking Finland.

Why the League failed was most dramatically illustrated when Italy attacked Ethiopia in October 1935. The Council declared that Italy had violated the Covenant. This action obligated League members to apply economic sanctions and to consider the use of force against Italy. Members agreed to stop all imports from Italy and to send no money or war material to Italy.

But the United States, Japan, and Germany were not League members. Therefore, the overwhelming "community of power" that Wilson had in mind for use against an aggressor was reduced to three nations—France, Great Britain, and the Soviet Union. The other League members did not have enough power to affect Italian policy. Even so, France, Great Britain, and the Soviet Union together would have been able to stop the Italian attack, if they had been united and determined to do so.

However, Britain and France were not willing to use force or to employ measures that might risk war. They even failed to use such economic measures as an oil embargo, which would have seriously hurt the Italian war effort. By May 1936, Italy had conquered Ethiopia. The League cancelled its sanctions in July.

French policy was the main reason for the failure of the League. Great Britain and the Soviet Union might have taken stronger actions against Italy if France had supported them. But France feared another war with Germany, and wanted Italy as an ally. It made no sense to French leaders to lose the friendship of Italy just to protect the independence of Ethiopia. The Ethiopian case completely discredited the League as an instrument to keep the peace.

See also **United Nations; International relations; Mandated territory; Wilson, Woodrow; World War II** (Nationalism).

Leakey family includes three noted anthropologists—a husband and wife and their son—who made important discoveries in eastern Africa concerning the origins of human beings. They are Louis Leakey, Mary Leakey, and Richard Leakey.

Louis Seymour Bazett Leakey (1903-1972) was largely responsible for convincing scientists that Africa was the most significant area to search for evidence of human origins. Most anthropologists had looked for such evidence in Asia because of the discovery of human fossils in Java (now part of Indonesia) and China.

Leakey began leading fossil-hunting expeditions to eastern Africa during the 1920's. He married Mary Nicol in 1936, and the couple discovered many important fossils together. These included the remains of apelike animals that lived in what is now Kenya between 14 million and 20 million years ago. During the early 1960's, an expedition led by Louis Leakey found fossils at Olduvai Gorge in Tanzania that he considered were the remains of an early human being. Leakey and other scientists named the species *Homo habilis* and identified it as the earliest member in the genus of human beings (see **Homo habilis**).

Leakey was born in Kabete, Kenya, near Nairobi. He wrote a two-volume autobiography, *White African* (1937) and *By the Evidence* (1974).

Mary Douglas Leakey (1913-) has also worked chiefly in Kenya and Tanzania. She achieved distinction for her description of the sequence in which early stone tools came into use. In 1948, she found the skull of an apelike animal named *Proconsul* that lived about 18 million years ago in Kenya. In 1959, she found the skull of a humanlike creature at Olduvai Gorge. This creature, first named *Zinjanthropus* but now called *Australopithecus boisei,* lived about 1,750,000 years ago. This discovery was one of the first indications that humanlike beings lived in prehistoric eastern Africa. See **Zinjanthropus.**

In 1978, a team led by Mary Leakey found a trail of footprints preserved in volcanic ash at Laetoli, Tanzania. Most scientists believe these prints and other fossils from the site are from humanlike creatures that lived about 3,700,000 years ago. The specimens provide evidence that these creatures walked upright. See **Australopithecus.**

Mary Douglas Nicol was born in London. Her books include *Africa's Vanishing Art: The Rock Paintings of Tanzania* (1983) and an autobiography, *Disclosing the Past* (1984).

Richard Erskine Frere Leakey (1944-) has found many important fossils at Lake Turkana in Kenya. There, in 1972, Leakey discovered part of the skull of a prehistoric human who lived about 1,900,000 years ago. Most scientists believe the skull belonged to *Homo habilis.* It is one of the oldest known *Homo habilis* fossils.

In 1975, Leakey uncovered the skull of a more advanced type of prehistoric human being known as *Homo erectus.* This skull, also found at Lake Turkana, was about 1,600,000 years old. In 1984, Kamoya Kimeu, a Kenyan working with Leakey's expedition, discovered an almost complete *Homo erectus* skeleton at Lake Turkana. See **Homo erectus.**

Leakey was born in Nairobi, Kenya. He served as director of the National Museums of Kenya from 1968 to 1989. In 1989, he became head of the country's Wildlife Conservation Services. In 1990, this organization became the Kenya Wildlife Service, an independent service that works in cooperation with the government. Leakey resigned his position there in 1994. Among his books are *The Making of Mankind* (1981) and an autobiography, *One Life* (1983).

Lean, Sir David (1908-1991), was a highly acclaimed English film director. He won Academy Awards as best director for *The Bridge on the River Kwai* (1957) and *Lawrence of Arabia* (1962).

Lean was born in Croydon. He began his film career in London at the age of 19. He performed a variety of duties before becoming a successful film editor in the mid-1930's. Lean made his debut as a director in *In Which We Serve* (1942), which he co-directed with English playwright Sir Noel Coward. The film won praise for its portrayal of the heroism of British sailors during World War II (1939-1945).

Lean directed two popular films adapted from the novels of English author Charles Dickens, *Great Expectations* (1946) and *Oliver Twist* (1948). He also directed the comedy fantasy *Blithe Spirit* (1945), the love stories *Brief Encounter* (1945) and *Summertime* (1955), the Russian historical epic *Dr. Zhivago* (1965), and *A Passage to India* (1984), based on the novel by E. M. Forster. Lean produced and directed *The Sound Barrier* (1952), an exciting aviation drama. Lean was knighted in 1984.

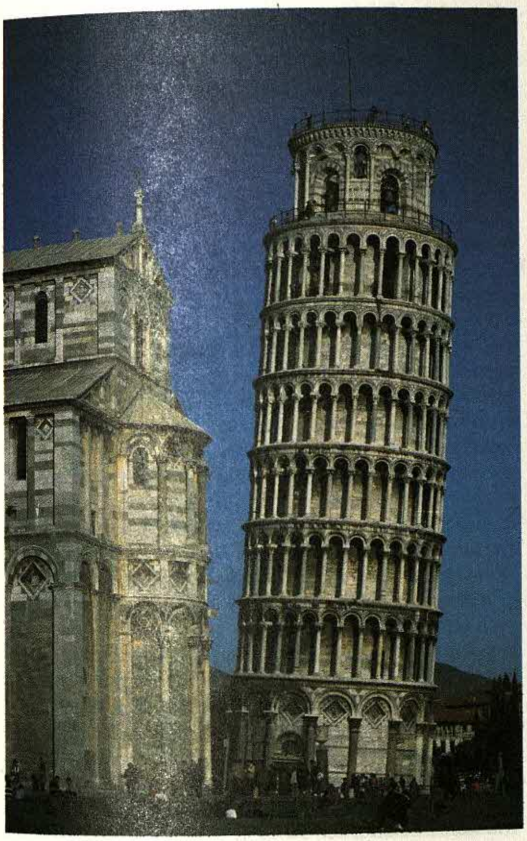
Leander. See **Hero and Leander.**

Leaning Tower of Pisa is a bell tower at Pisa, Italy. The structure is famous for leaning 4.4 metres out of line when measured from the seventh storey. It inclines because its foundation was built on unstable soil. Construction of the tower began in 1173 and was completed between 1360 and 1370. The ground beneath the tower first started to sink after the first three storeys were built. The tower was closed in the early 1990's, to allow for urgently needed repairs.

The tower, or *campanile,* is part of a complex of three buildings, consisting of a baptistery, a church, and the bell tower. Together the three structures form the Cathedral of Pisa. While most cathedrals in Europe combine the baptistery, church, and tower in a single building, the Italians frequently separated them, as at Pisa. Built during the Romanesque historical period, the three buildings are noted for their beauty, their colourful marble, and many decorative arches.

The tower is 15.5 metres in diameter and about 55 metres tall. The walls are 4 metres thick at the base and from 1.8 to 2.1 metres thick at the top. Fifteen arches surround the tower on the ground floor, and 30 arches encircle each of the next six storeys. The top storey, which houses the bells, has 12 arches. An inner staircase of almost 300 steps leads to the top.

Leap year has 366 days, or one more day than an ordinary year. A leap year occurs in every year that can be divided evenly by four, except the years that mark the even hundreds, such as 1500. The only century years that are leap years are those that can be divided evenly by 400, such as 1600 and 2000. Leap years were added to the calendar to make the calendar year nearly the same as the solar year, which is the time it takes for the sun to pass the vernal equinox twice. The extra day is added to the end of February and occurs as February 29 once every four years. See also **Year.**



The Leaning Tower of Pisa was built as a bell tower for the Pisa Cathedral, *left.* The tower, constructed from 1173 to 1372, leans because its foundation lies on a layer of unstable subsoil made up of a mixture of sand, clay, and water.

Lear, King. See **Shakespeare, William** (Shakespeare's plays).

Lear, Edward (1812-1888), an English writer and artist, became famous for his humorous poems for children. Lear's first book of poems, *A Book of Nonsense* (1846), ranks as a masterpiece of children's literature. His best-known poem, "The Owl and the Pussy-Cat" (1871), also became a classic. Lear became especially noted for his short rhymed verses called *limericks.* One of these appears in the *World Book* article on **Limerick.**

Lear was born in London. He began to earn his living at the age of 15 by drawing birds and doing other art work. Lear established a reputation as a natural-history artist with his first book of drawings of parrots, published in 1832. He also became known for his detailed landscape paintings. During the mid-1830's, while drawing and painting for a living, Lear began to write nonsense verse for children. However, none of his verses was published until 1846. Lear also drew many illustrations for his books.

Learning is an important field of study in psychology. Psychologists define learning as the process by which changes in behaviour result from experience or practice. By *behaviour,* psychologists mean any response that an organism makes to its environment. Thus, behaviour includes actions, emotions, thoughts, and the responses of muscles and glands. Learning can produce changes in any of these forms of behaviour.

Not all changes in behaviour are the result of learning. Some changes result from *maturation* (physical growth). Others, including those caused by illness or fatigue, are only temporary and cannot be called learning.

How we learn

We can see learning taking place all the time, but there is no simple explanation of the process. Psychologists have examined four kinds of learning in detail: (1) classical conditioning or respondent learning, (2) instrumental conditioning or operant learning, (3) multiple-response learning, and (4) insight learning.

Classical conditioning is based on stimulus-response relationships. A *stimulus* is an object or a situation that excites one of our sense organs. A light is a stimulus because it excites the retina of the eye, allowing us to see. Often a stimulus makes a person *respond* in a certain way, as when a flash of light makes us blink. Psychologists say that in this instance the stimulus *elicits* (draws forth) the response.

In classical conditioning, learning occurs when a new stimulus begins to elicit behaviour similar to that originally produced by an old stimulus. For example, suppose a person tastes some lemon juice, which makes the person salivate. While the person is tasting it, a tone is sounded. Suppose these two stimuli—the lemon juice and the tone—occur together many times. Eventually, the tone by itself will make the person salivate. Classical conditioning has occurred because the new stimulus (the tone) has begun to elicit the response of salivation in much the same way as the lemon juice elicited it.

Any condition that makes learning occur is said to *reinforce* the learning. When a person learns to salivate to a tone, the reinforcement is the lemon juice that the tone is paired with. Without the lemon juice, the person would not learn to salivate to the tone.

The classical conditioning process is particularly important in understanding how we learn emotional behaviour. When we develop a new fear, for example, we learn to fear a stimulus that has been combined with some other frightening stimulus.

Studies of classical conditioning are based on experiments performed in the early 1900's by the Russian physiologist Ivan P. Pavlov. He trained dogs to salivate to such signals as lights, tones, or buzzers by presenting these signals when he gave food to the dog (see **Reflex action**). Pavlov called the learned response a *conditioned response* because it depended on the conditions of the stimulus. To emphasize the fact that a stimulus produces a response in this kind of learning, classical conditioning is often called *respondent learning.*

Instrumental conditioning. Often a person learns to perform a response as a result of what happens after the response is made. For example, a child may learn to beg for sweets. There is no one stimulus that elicits the response of begging. The child begs because such behaviour occasionally results in receiving sweets. Every time the child receives sweets, the tendency to beg becomes greater. Sweets, therefore, are the reinforcer. Instrumental conditioning is also called *operant conditioning* because the learned response *operates* on the environment to produce some effect.

The American psychologist B. F. Skinner performed important experiments with instrumental conditioning in the 1930's. He trained rats to press levers to get food. In one experiment, a hungry rat was placed in a special box containing a lever attached to some concealed food. At first, the rat ran around restlessly. Eventually, it happened to press the lever, and the food dropped into the box. The food reinforced the response of pressing the lever. After repeating the process many times, the rat learned to press the lever for food.

Skinner's experiments were based on those performed earlier in the 1900's by the American psychologist E. L. Thorndike. In Thorndike's experiments, an animal inside a puzzle box had to pull a string, press a pedal, or make some other response that would open the box and expose some food. Thorndike noted that the animal learned slowly and gradually. He called this type of learning *trial-and-error behaviour.*

Multiple-response learning. When we learn skills, we first learn a sequence of simple movement-patterns. We combine these movement-patterns to form a more complicated behaviour pattern. In most cases, various stimuli guide the process. For example, operating a typewriter requires putting together many skilled finger movements. These movements are guided by the letters or words that we want to type. At first, a person has to type letter by letter. With practice, the person learns to type word by word or phrase by phrase. In verbal learning, such as memorizing a poem or learning a new language, we learn sequences of words. We then combine these sequences of responses into a complex organization. Learning that involves many responses requires much practice to smooth out the rough spots.

To examine this kind of learning, psychologists have observed animals learning to run through a maze. Starting at the beginning, the animal wanders through the maze until it finds food at the end. The animal periodically comes to a choice-point, where it must turn right or left. Only one choice is correct. Eventually the animal learns the correct sequence of turns. Psychologists have found that the two ends of the maze are learned more easily than the parts near the middle. In the same way, when we learn a list of things, we usually find the beginning and end easier than the middle.

Insight learning. The term *insight* refers to solving a problem through understanding the relationships of various parts of the problem. Insight often occurs suddenly, such as when a person looks at a certain problem for some time and then suddenly grasps its solution.

The psychologist Wolfgang Köhler performed important insight experiments in the early 1900's. He showed that chimpanzees sometimes use insight instead of trial-and-error responses to solve problems. When a banana was placed high out of reach, the animals discovered that they could stack boxes on top of each other to reach it. They also discovered how to put two sticks together to reach an object that was too far away to reach with one stick. The chimpanzees appeared both to see and to use the relationships involved in reaching their goals.

Theories of learning are based on facts obtained from experiments such as those on classical and instrumental conditioning. Psychologists differ in their interpretation of these facts. As a result, there are a number of learning theories. These theories can be divided into three groups.

One group of psychologists emphasizes stimulus-response relationships and has performed experiments with classical and instrumental conditioning. They say all learning is the forming of habits. When we learn, we connect a stimulus and a response that did not exist before, thus forming a habit (see **Habit**). Habits can range from the simplest ones to complex ones that are involved in learning skills. These psychologists believe that when we meet a new problem, we use appropriate responses learned from past experience to solve it. If this procedure does not lead to the solution, we use a trial-and-error approach. We use one response after another until we solve the problem. The stimulus-response approach has been used to explain and modify bad habits. For example, when a person is irrationally afraid of dogs, methods called *behaviour modification* can be used to replace the fear response to a dog with a more relaxed response.

A second group of psychologists stresses *cognition* (the act of knowing) above the importance of habit. These experts feel that experiments with classical and instrumental conditioning are too limited to explain such complex learning as understanding concepts and ideas. This approach emphasizes the importance of the learner's discovering and perceiving new relationships and achieving insight and understanding.

A third group of psychologists has developed *humanistic* theories. According to these theories, much human learning results from the need to express creativity. Almost any activity, including athletics, business dealings, and homemaking, can serve as a creative outlet. The psychologists in this group believe that each person must become involved in challenging activities—and must do reasonably well at them—to have a satisfying life. The individual gains a sense of control, growth, and knowledge from such activities. For learning to occur, people must feel free to make their own decisions. They also must feel worthy, relatively free from anxiety, self-respecting, and respected by others. Under these conditions, their own inner drives will lead them to learn. Some kinds of group therapy try to provide an accepting, supporting environment. Such an environment is intended to increase people's awareness of their own thoughts and of the world around them.

Learning involves changes in the nervous system. Scientists are trying to discover the processes that take place in the brain to produce learning. Such research may lead to a physiological theory of learning.

Efficient learning

Readiness to learn. Learning occurs more efficiently if a person is ready to learn. This readiness results from a combination of growth and experience. Children cannot learn to read until their eyes and nervous systems are mature enough. They also must have a sufficient background of spoken words and prereading experience with letters and pictures.

Motivation. Psychologists and educators also recognize that learning is best when the learner is motivated to learn (see **Motivation**). External rewards are often used to increase motivation to learn. Motivation aroused by external rewards is called *extrinsic motivation.* In other cases, people are motivated simply by the satisfaction of learning. Motivation that results from such satisfaction is called *intrinsic motivation.* This type of motivation can be even more powerful than extrinsic motivation. Punishment, particularly the threat of punishment, is also used to control learning. Experiments have shown that intrinsic and extrinsic rewards serve as more effective aids to learning than punishment does. This is due largely to two factors: (1) learners can recognize the direct effects of reward more easily than they can the effects of punishment; and (2) the by-products of reward are more favourable. For example, reward leads to liking the rewarded task, but punishment leads to dislike of the punished deed.

Psychologists also look at the motivation of learning from the point of view of the learner. They tend to talk about success and failure, rather than reward and punishment. Success consists of reaching a goal that learners set for themselves. Failure consists of not reaching the goal. An ideal learning situation is one in which learners set progressively more difficult goals for themselves, and keep at the task until they succeed.

Skill learning and verbal learning. Through research, psychologists have discovered some general rules designed to help a person learn.

The following rules apply particularly to learning skills. (1) Within a given amount of practice time, you can usually learn a task more easily if you work in short practice sessions spaced widely apart, instead of longer sessions held closer together. (2) You can learn many tasks best by imitating experts. (3) You should perform a new activity yourself, rather than merely watch or listen to someone. (4) You learn better if you know immediately how good your performance was. (5) You should practise difficult parts of a task separately and then try to incorporate them into the task as a whole.

Two additional rules apply mainly to verbal learning. (1) The more meaningful the task, the more easily it is learned. You will find a task easier to learn if you can relate it to other things you have learned. (2) A part of a task is learned faster when it is distinctive. When studying at school or college, for example, underlining a difficult passage in your notes in red makes the passage distinctive and easier to learn.

Transfer of training. Psychologists and educators recognize that new learning can profit from old learning because learning one thing helps in learning something else. This process is called *transfer of training.*

Transfer of training can be either positive or negative. Suppose a person learns two tasks. After learning Task 1, the person might find Task 2 easier or harder. If Task 2 is easier, then the old learning has been a help and positive transfer of training has occurred. If Task 2 is harder, the old learning is a hindrance and negative transfer has occurred.

Whether transfer is positive or negative depends on the relationship between the two tasks. Positive transfer occurs when the two tasks have similar stimuli and both stimuli elicit the same response. For example, if we know the German word *gross,* it is easier to learn the French word *gros* because both words mean *large.* In this case, similar stimuli *(gross* and *gros)* elicit the same response *(large).*

Negative transfer occurs when the two tasks have similar stimuli, which elicit different responses. After you learn the German word *Gras* (grass), it is harder to learn the French word *gras* (fat). The words are spelled the same way, but they have different meanings. In this case, similar stimuli *(Gras* and *gras)* elicit different responses.

Psychologists believe new learning can profit from old learning because of three factors: (1) positive transfer of training, (2) general principles that we learn in one task and apply to another task, and (3) good study habits that we learn in one task which help us learn another task.

Related articles in ***World Book*** include:

Animal (Behaviour; Intelligence of animals)
Association
Behaviour
Comparative psychology
Developmental psychology
Instinct
Köhler, Wolfgang
Learning disabilities
Memory
Motivation
Pavlov, Ivan P.
Perception
Personality
Piaget, Jean
Psychology (History)
Skinner, B. F.
Teaching machine
Testing
Thorndike, Edward L.
Tolman, Edward C.

Learning disabilities are disorders that can interfere with the development of basic skills and so damage a child's ability to learn. Children with learning disabilities may have average or above-average intelligence, and they also have normal hearing and vision. But they apparently cannot use information transmitted by the senses to the brain as accurately as most other children can. Therefore, they do poorly in school, or not as well as they might.

Causes. Doctors cannot always discover the specific cause of a child's learning disability. But scientists believe that most learning disabilities result from minor damage to the brain or to major nerves leading to the brain. For example, illness or poor nutrition in a pregnant woman can injure the brain tissue and nervous system of her unborn child. The use of drugs, tobacco, or alcohol during pregnancy may also contribute to the development of learning disabilities. Brain damage can occur at birth if the baby's brain does not receive enough oxygen. Such damage can take place during a long, difficult birth or if the mother receives an overdose of a pain-killing drug. A child also may inherit a learning disability.

Many other factors may increase a child's chances of developing a learning disability. An imbalance of certain chemicals in the body or a lack of nutritious foods can delay or permanently damage the development of the nervous system. Medical research suggests that certain chemicals, especially lead used in paint, may trigger learning disabilities in some children.

Even a child with no physical problem may develop a learning disability. Disabilities can result from a lack of the early learning experiences that stimulate mental growth and development. These experiences include hearing language and manipulating objects.

Types. There are many types of learning disabilities. For example, *perceptual disorders* hinder the brain's ability to organize and interpret sights and sounds. Children with a perceptual disorder may be unable to pinpoint where one word ends and another begins on a page. Or such children may not be able to distinguish between words that sound somewhat alike. Perceptual disorders make learning to speak and read difficult.

Another type of learning disability affects memory. Children with this problem cannot easily recall what familiar objects look like or what sounds the objects make. They may not be able to learn a sequence, such as the alphabet or a telephone number.

Other learning disabilities interfere with the ability to behave properly and to concentrate. Disabilities that affect a child's concentration are known as *attention deficit disorders. Distractible* children daydream almost constantly. They cannot direct their attention to any topic for more than a few minutes. In contrast, children with a disability called *perseveration* cannot easily shift their attention from one activity to another. They may continue working at a task long after it has been finished. *Hyperactive,* or *hyperkinetic,* children cannot sit still. They speak and act on impulse and tend to become impatient and boisterous in class. A child with *emotional lability* has changes in mood for no apparent reason.

An *orientation-related disability* damages a child's sense of direction, distance, and space. Individuals with this problem may be unaware of where they are and feel lost even in familiar surroundings. They cannot distinguish left from right or up from down. They become poor readers because they cannot remember to read from left to right. They also may not recognize the difference between letters that resemble each other, such as *b* and *d*.

Other types of learning disabilities interfere with effective muscle control and can cause clumsiness and loss of balance. Some of these disabilities prevent specific movements necessary for certain activities. For example, *dyspraxia* is the inability to properly move the lips, tongue, and other parts of the body in speech. *Dysgraphia* affects the brain's control of the small finger muscles used in writing.

Learning disabilities that block the development of language skills are called *psycholinguistic disabilities.* One such condition, called *dysphasia,* interferes with the ability to produce or understand human speech. *Dyslexia* damages a child's capacity to understand printed or written words. Learning problems that hinder a child's progress in particular subjects, such as arithmetic or spelling, are *specific learning disabilities.*

Disorders called *nonverbal learning disabilities* interfere with a child's ability to understand the facial expressions and other gestures of other people. These disabilities can make it difficult for a child to get along with others, or they may cause the child to behave inappropriately.

Diagnosis and treatment. Not all learning and behavioural problems are caused by learning disabilities. Parents who suspect that their son or daughter may have a learning disability should have the child examined by specialists. Tests by a *paediatrician* (children's doctor), eye and ear specialists, a psychiatrist, and a social worker may find other possible causes of the problem. Such causes include emotional disturbances, mental retardation, and poor hearing and vision. If the test results are normal, a doctor called a *neurologist* should examine the child for evidence of damage to the brain or nervous system.

The method of treatment suggested by the teacher depends on the type and extent of the disability. Some learning-disabled children learn best in special classes with others who have similar problems. But many youngsters can do exercises to improve their weak skills in classes with nonhandicapped children. The use of medication has helped many children who have attention deficit disorders. Some learning experts suggest more controversial treatments for learning disabilities, including biofeedback, special diets, and exercises (see **Biofeedback**). Special counselling is often helpful for families that include children with learning disabilities. Such counselling increases the families' ability to understand the children and to help the children deal with the stress that they experience in school as a result of their disorders.

See also **Dyslexia; Hyperactive child.**

Lease is a contract between a person with a legal interest in land or other property and a person who rents it from that person. The person who grants the lease is called the *lessor.* The person to whom the lease is granted is called the *lessee,* or *tenant.* A lease is sometimes called a *tenancy.* The compensation which the tenant agrees to pay the lessor is called the *rent.*

A lease for life ends when the tenant dies. A lease for a term of years begins and ends at dates set in the lease. The lease does not end when the tenant or lessor dies, but is binding on the heirs of both parties. Some leases are for a long period, such as 99 years. Such leases usually give the lessee greater privileges than those granted a short-term tenant.

A lease must grant the tenant exclusive possession of the property. If it does not it is known as a *licence,* which is a right simply to use the property in some way.

Rents are generally paid in money, although occasionally they are paid in goods. For example, a person who rents a farm may agree to pay with crops.

A lease must include certain items of information to be a legal contract. These include the names of the lessor and tenant, the dates of the beginning and end of the lease, the amount of rent, a complete description of the property, and a complete statement of the rights and duties of each party.

See also **Contract; Tenant.**

Leather is a tough, flexible material made from the skin of animals. Cattle hides provide the source of most leathers, but deer, goat, pig, and sheep skins are also widely used. Speciality leathers are made from alligator, shark, and snake hides. The process of turning the animal skin into a leather product that can be made into useful objects is called *tanning.*

Leather is used to make shoes, boots, belts, gloves, jackets, hats, shirts, trousers, skirts, handbags, and many other objects. Baseballs, basketballs, cricket balls, and footballs have leather covers. Industries use drive belts made from leather, and cars, trucks, and buses run on bearings protected by leather seals.

Leather is strong and durable. It can be made as flexible as cloth or as stiff as wood. Some kinds of leather are thick and heavy, but others are thin. Leather can be dyed, polished to a glossy finish, or *embossed* (decorated with raised figures).

People have known how to make leather since prehistoric times. Some tanning methods that were developed by the ancient Greeks and Romans are still in use.

Leather is used to make a wide variety of products. The type of leather used depends on the product. This photo shows a handbag made of *chrome-tanned leather,* shoes made of highly polished, glossy *patent leather,* a hat made of soft leather called *suede,* and a polishing cloth made of clothlike *chamois.*

Kinds of leather

The chief kinds of leather are *shoe sole leather, shoe upper leather, chamois,* and *suede.* Shoe sole leather is produced from the thick skins of cattle and other large animals. Shoe upper leather is obtained from the thinner skins of calves, goats, and other smaller animals or by splitting heavy hides into thin layers. About 80 per cent of all tanned leather is made into shoes and other footwear.

Chamois leather was originally made from the chamois, an animal that lives in Europe and Asia and resembles the antelope. But today, most chamois leather is made from split sheepskin. Properly tanned chamois leather is as soft as cloth and will hold water like cloth. Chamois leather is often used as a washing and polishing cloth.

Suede leather is often made from the inside flesh layer of a cowhide that has been split. In the past, goatskins or sheepskins were used for this leather. Suede is soft, flexible, warm, and water-resistant. This kind of leather is used to make jackets, coats, dresses, trousers, and shoe uppers.

How leather is made

Preparing the hides. Before animal hides can be tanned, they must undergo certain preparations. These preparations include (1) curing, (2) fleshing, (3) unhairing, and (4) bating.

Curing. Most animal hides used to make leather come from a meat processor or slaughterhouse. The skins are cured before they start the trip to the tannery to keep them from rotting. Hides are cured by applying salt to the flesh side of the skin, by soaking them in *brine* (salty water), by partially drying and salting them, or by just drying them. After they are cured, the skins are stacked in revolving drums filled with water. The water removes dirt and blood, washes out most of the salt, and replaces the moisture lost during the curing process.

Fleshing. After the skins are washed and remoisturized, they are fleshed. Workers run the hides across a fleshing machine equipped with sharp knives, removing all fat and meat on the flesh side of the skin. More and more hides are now being fleshed at the meat processing house, thereby eliminating the fleshing step at the tannery.

Unhairing. Workers put the fleshed hides in vats containing a lime and water solution that has a small amount of the chemical sodium sulphide. The solution weakens the hair roots by chemical action, and in a few days the hair is loose. The hides are then run through an unhairing machine that scrapes the hair away. The hair is kept for use in making felt and other products. After unhairing, the hides are refleshed to remove bits of fat loosened by the unhairing process. Then, they are washed in clean water.

Bating. After unhairing, the skins are bated—that is, they are placed in a mild acid bath to neutralize the unhairing solutions left in them. This process is necessary because the solutions used for tanning are acidic. If the alkaline solutions used for unhairing were not neutralized in this way, they could prevent the tanning solutions from penetrating the skin. Enzymes are also added to the bath to digest soluble proteins in the hide that could interfere with the tanning process.

Tanning. After the hides have been cured, fleshed, unhaired, and bated, they are ready for tanning. There are four chief methods of tanning hides: (1) vegetable tanning, (2) chrome tanning, (3) combination tanning, and (4) oil tanning.

Vegetable tanning is generally carried out in large vats filled with tanning solutions, which are made from water and *tannin.* Tannin is a bitter substance that is obtained from such plants as the chestnut, hemlock, mangrove, oak, and quebracho trees.

Workers increase the strength of the tanning solution in proportion to the time the hide is left in the solution. Tanning solutions commonly start at about 0.5 per cent tannin and are increased to as much as 25 per cent tannin by the completion of the tanning process. Vegetable tanning usually takes from one to three months, but thick skins are sometimes tanned for a year.

Vegetable-tanned leather is firmer and more water-resistant than chrome-tanned leather. Vegetable-tanned leather may be *stuffed*—that is, materials such as fats and oils may be worked into it. Stuffing makes the leather water-repellant and more resistant to wear. Vegetable-tanned leather is made into bookbindings and heavy belts for machinery. Pure vegetable tanning is also used for such speciality leathers as *basil,* made from sheepskin; some pigskin; and buffalo, ostrich, rhinoceros, and walrus hides.

Chrome tanning is the most widely used mineral tanning process. It is performed with a tanning solution of *chrome salts* (compounds of chromium). Before skins are chrome tanned, they are *pickled* (soaked in a solution of sulphuric acid and salt). The skins are soaked until their acidic content reaches a predetermined level. Then they are removed and washed.

After washing the skins, workers place them in tanning drums that are filled with water and chromium sulphate. The chromium sulphate solution tans the skins and gives them a light blue colour as well. The skins are usually completely tanned in a few hours.

Chrome-tanned leather can be made much faster than vegetable-tanned leather. It is also more resistant to heat and scratching, more flexible, and easier to soften. Leather for shoe uppers, gloves, wallets, luggage, and upholstery is generally chrome tanned. However, some of these leathers are retanned with *syntans* (synthetic tanning materials), vegetable-tanning solutions, or substances containing formaldehyde, to give them special characteristics.

Combination tanning involves the use of both the chrome-tanning and vegetable-tanning methods. Combination tanning is used for leathers with special qualities, such as extremely soft garment, glove, or shoe upper leathers. In today's tanneries, most leather is chrome tanned, either as the complete tanning process, or as a *pretan* for vegetable tanning. Pretanning speeds up the vegetable-tanning process and also gives vegetable-tanned leather more flexibility. Some shoe soles are vegetable tanned, but usually they are pretanned with a chrome tan.

Oil tanning is used for the chamois leather that is made from sheepskin. First the wool is removed from the sheepskin and the skin is split into layers. The flesh *split* (side) is used for chamois, and workers begin by shaving the split to remove the fat cells. Next, they put the shaved split into a machine that hammers cod-liver oil into the skin. After the oil has penetrated it, the skin is removed from the machine and dried. It is then buffed to soften it and to give it a *nap* (soft, woolly surface). Saddle leather and leather seals used on some machinery are also oil tanned. However, they are pretanned with chrome before being oil tanned.

Final processing that is carried out after the skins are tanned includes (1) splitting, (2) dyeing, (3) staking, and (4) finishing.

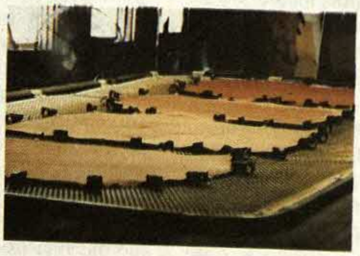
Splitting. The tanned skins are removed from the tanning materials and dried. Some are then split by a machine that cuts the skins into two layers. The top layer is called *top grain.* The bottom, or flesh, layer is often called *suede leather.* The skin is further divided into four sections. The *bend* section is the skin on either side of the backbone from the rump to the shoulder. The bend section provides the finest leather. The *shoulder* section is also fine leather, but it often is wrinkled. The *head* section is good leather, but the pieces are small and uneven. The *belly* section is poorest in quality because it is uneven and tends to stretch.

Dyeing. Almost all leather is dyed after tanning. Dyeing is often done in large drums similar to those used in chrome tanning. Leather can be dyed with a number of aniline dyes, natural wood dyes, acid dyes, and even some tanning agents. The dyeing takes place while the skin is being tumbled with a mixture of warm water and the dyeing material. Oil is usually added to further soften the skin. After the hide is dyed and the oil added, it is dried in drying vats, by pasting the hide onto a glass plate or a metal sheet. The hide may also be dried by *toggling* (pinning) it to a large wooden sheet with holes in it.

Staking. Some leather must be made softer after it is dyed. The dried skin is partially remoisturized by putting it in a room with a highly humid atmosphere, or by covering it with damp sawdust or a similar material. Then it is put on a staking machine, where steel pegs stretch and work the leather to soften it. If extremely soft leather

How leather is made

Tanning begins as workers place the animal hides in a solution of certain chemicals and water. The solution loosens the hair on the hides.



Leather is dried following the tanning process. In one drying method, the leather is stretched on large wooden *toggling frames* that have holes in them.

Some leather is split into layers by a splitting machine. Workers measure the thickness of the layers with a special gauge.

Dry milling is one of several methods used to soften leather. In this method, workers place the leather in large drums and then tumble it for hours.

A seasoning machine smooths the surface of the leather. The rollers apply such seasoning materials as pigments, shellacs, and waxes.

Finishing includes spraying the leather with such substances as proteins, waxes, and oils. The spraying machine above is activated by a computer.

Leather from the past has often survived in good condition because of its durable quality. The leather sandals from ancient Egypt, *far left,* are about 2,000 years old. The Spanish leather gameboard and box, *left,* was probably made in the 1700's.

is desired, it is tumbled in wooden drums. Glove leather is often softened in this way.

Finishing. After staking, the leather is ready for the final finishing process. *Casein* (a protein found in milk), other substances obtained from blood and milk, waxes, and oils are some of the materials used for a final finish on leather. The finish is sprayed on in layers. Between applications, a cylindrical piece of glass or steel is rolled over the leather to smooth and glaze it. The most highly polished leather is called *patent leather.* It is produced by applying successive coats of heavy oil varnish at the end of the finishing process. This varnish gives patent leather a high, durable gloss.

History

People have tanned animal skins since prehistoric times. The ancient Egyptians made such durable leather that specimens over 3,000 years old have been discovered in almost perfect condition. Evidence of oil tanning has been found in leather from Egyptian tombs. The early Greeks and Romans also made contributions to the science of leathermaking. Some of their methods are still in use today.

Many ancient peoples tanned their leather by placing layers of bark, leaves, and fruit over hides and adding water. This process took months, and in the case of thick skins, even years. As early as 800 B.C., people discovered the mineral salt alum and began using it as a tanning agent. The Assyrians, Babylonians, Greeks, and Sumerians used this mineral method of tanning because it was much faster than the techniques that had previously been used.

In some societies, leather has been used widely. For example, the American Indians used deerskins to make leather for their moccasins, cloaks, and tents. Leather also became one of the most-extensively used materials for the settlers to the United States.

In 1809, Samuel Parker, an American inventor, patented the leather splitting machine. This machine allowed workers to make two skins out of one, thereby doubling production. Fleshing and unhairing machines were invented shortly after the splitting machine.

Manufacturers did not begin producing leather for a large market until the 1800's. Then, leather became more widely available as the standard of living rose. As more cattle began to be consumed for meat, more hides became available for tanning. Augustus Schultz, an American dye salesman, invented a chrome-tanning process in 1884. The method was perfected about 10 years later by Martin Dennis. Chrome tanning allowed more attractive and flexible leathers to be produced at a much faster rate.

Because of the increasing demand for leather, researchers have developed synthetic leather. Synthetic leather closely resembles natural leather and has many uses. However, it does not have natural leather's ability to *breathe*—that is, to allow perspiration to escape without letting in water from the outside.

Related articles in ***World Book*** include:

Buckskin
Chamois
Crocodile
Leathercraft
Shoe
Suede

Leathercraft is the art of making useful and decorative objects out of leather. Suede and fur can also be used. The most popular leather-crafted objects include belts, handbags, saddles, and shoes. Leatherworkers also use leather to create furniture, jewellery, sculptures, and wallhangings.

Leather can be cut, carved, glued, sewn, dyed, and painted. It can also be combined with other materials, such as fabrics and wood, and with other craft techniques, including weaving and macramé. Basic leatherworking consists of four procedures: (1) designing, (2) cutting and assembling, (3) colouring, and (4) finishing.

Designing involves drawing the desired pattern onto the leather. The leatherworker may use chalk or pencil.

Cutting and assembling. Sharp instruments must be used for cutting. These instruments range from knives and household scissors to special leather-cutting shears. The choice of cutting tool depends on the thickness of the material. For example, thick shoe leather requires sharp knives while suede, which is thinner, can be cut with a pair of scissors. Most cuts within the leather are made with special punches. These are sharp steel tools with points in a variety of shapes, such as ovals, diamonds, or stars. The leatherworker places the sharp end of the punch on the leather and drives it into the surface by hitting the blunt end with a rawhide mallet. Designs can be added by *tooling* the surface with chrome-plated carving and stamping instruments. See **Embossing.**

The leatherworker can assemble the leather parts in several ways. For example, he or she can make a series of evenly spaced holes or slits with a leather punch or a pronged chisel. The parts are then assembled by lacing or stitching. Pieces can also be attached by gluing or by nailing one to another with special brads. Leather can be shaped by wetting the material and then folding it or tacking it onto a wooden form. The leather retains the shape of the fold or the form after it dries.

Colouring. Dyes in liquid or powder form are the most reliable for colouring leather. To produce deep

Leathercraft requires special tools. A leatherworker uses a swivel knife to carve designs into the leather, *above.*

tones, the leatherworker dampens the leather, thus allowing the dye to penetrate the pores of the material. Softer tones can be created by applying dyes to dry leather. Special colouring effects can be achieved by using household fabric dyes, acrylic paints, or wood stains. The surface may then be polished or buffed.

Finishing involves trimming, smoothing, and bevelling the edges. Then the surface is polished and buffed.

Leaven is a substance that causes fermentation of dough in breadmaking. A leaven acts by causing the formation of carbon dioxide gas which bubbles through and lightens and expands the batter or dough while it is baking. Yeast and baking powder are common leavens.

See also **Bread** (Kinds of bread; History); **Yeast** (How yeast is used).

Leaves. See Leaf.

Leaving Certificate examination is taken by pupils in the Republic of Ireland at the end of their secondary education courses. Students not in full-time education may also take the Leaving Certificate examination, provided they are more than 17 years old. The Department of Education prepares the examination syllabus.

Leavis, F. R. (1895-1978), was one of the most important English literary critics of the 1900's. His ideas about the relation between literature and society strongly influenced the study of English literature.

Leavis emphasized literature's involvement with the society out of which it grew. He argued that literature not only was a product of but also helped to produce the culture of its time. With his wife, Queenie Roth Leavis, he was a founder of *Scrutiny,* a critical journal. Leavis was the main editor of *Scrutiny* from 1932 to 1953.

In his early books, Leavis favoured poets with a "plain" style, such as Geoffrey Chaucer and William Wordsworth. He attacked established "greats," such as Edmund Spenser and John Milton. These views appear in *New Bearings in English Poetry* (1932) and *Revaluation* (1936). In his later writings, Leavis examined the novel to establish a list of authors who combine great seriousness with an involvement in their society. He favoured such writers as Jane Austen, Emily Brontë, Joseph Conrad, George Eliot, and D. H. Lawrence. Leavis' later books include *The Great Tradition* (1948) and *D. H. Lawrence: Novelist* (1955).

Frank Raymond Leavis was born in Cambridge. He taught at Cambridge University from 1925 to 1964.

Leavitt, Henrietta Swan (1868-1921), was an American astronomer. Her work helped later astronomers establish the present scale of the size of the universe.

Leavitt became famous for her study of *Cepheid variables* in the galaxies called the Magellanic Clouds. A Cepheid variable is a type of star whose *luminosity* (brightness) changes regularly with time. The *period* of such a star is the time its light takes to change from bright to dark and back to bright. Leavitt discovered that stars with longer periods had greater average brightnesses than those with shorter periods. This relation, known as the *period-luminosity relation,* is used in many cases to calculate distances to stars and galaxies (see **Astronomy** [Measuring distances in space]).

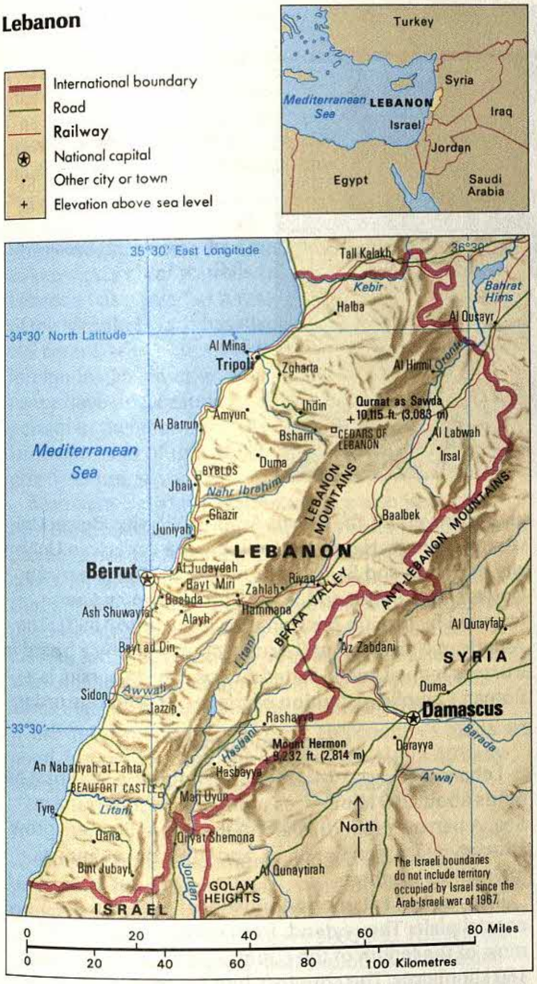
Leavitt was born in Lancaster, Massachusetts, U.S.A. In 1892, she graduated from the Society for the Collegiate Instruction of Women (now Radcliffe College).

Lebanon is a small country at the eastern end of the Mediterranean Sea and the western end of Asia. It has been a centre of transportation, trade, and finance for over 100 years. Sandy beaches lie along its coast, and rugged mountains rise in the interior.

For Lebanon's total population, see the *Facts in brief* table with this article. Beirut is the nation's capital and largest city. About a quarter of the country's people live in the Beirut area. Most people are Arabs. Almost all the people are either Christians or Muslims. Political differences between Lebanese Christians, and Lebanese Muslims and the Palestine Liberation Organization (PLO) erupted into civil war in the mid-1970's. Other rival

The snow-covered Lebanon Mountains rise above the town of Hammana in central Lebanon.

Lebanon



groups also engaged in fighting. The conflicts caused much death, destruction, and damage to the country's economy. A peace plan ended most of the fighting in 1991.

Government

Lebanon is a republic. The country's National Assembly (parliament) elects a president to a six-year term. The president appoints a prime minister. The prime minister and the president head the executive branch of the government. A Council of Ministers (cabinet) carries out the operations of the government. The National Assembly makes the country's laws. Its 128 members are elected by the people to four-year terms. Seats in the National Assembly have been divided equally between the two groups.

To maintain a balance between Christians and Muslims in Lebanon, the government has traditionally been composed of members of both groups on a proportional basis. Usually, the president has been a Maronite Christian and the prime minister a Sunni Muslim.

Lebanon is divided into five provinces, each of which is headed by a governor. Most of the provinces are divided into districts, which are governed by district heads. Lebanon's main courts are, from highest to lowest, the Court of Cassation, the Courts of Appeal, and the Courts of First Instance.

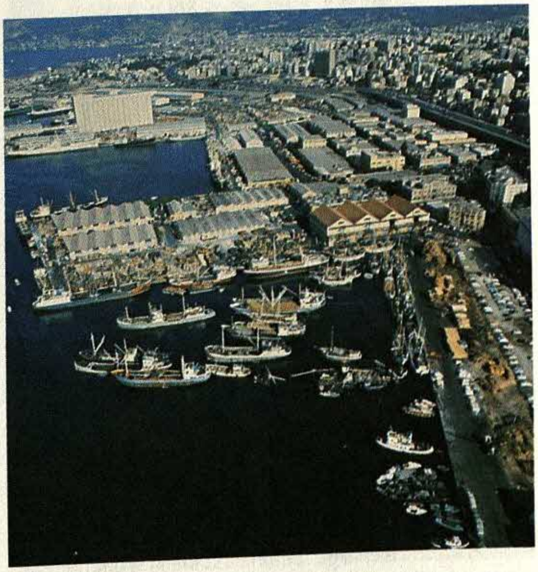
Facts in brief about Lebanon

Capital: Beirut.
Official language: Arabic.
Area: 10,400 km². *Greatest distances*—north-south, 193 km; east-west, 80 km. *Coastline*—210 km.
Elevation: *Highest*—Qurnat as Sawda, 3,083 m above sea level. *Lowest*—sea level.
Population: *Estimated 1996 population*—3,082,000; density 296 people per km²; distribution, 85 per cent urban, 15 per cent rural. *1970 census*—2,126,325. *Estimated 2001 population*—3,312,000.
Chief products: *Agriculture*—apples, cherries, cucumbers, grapes, lemons, oranges, peaches, sugar beet, tomatoes. *Manufacturing*—cement, chemicals, electric appliances, furniture, processed foods, textiles.
Flag: The flag has three horizontal stripes—red, white, and red. A cedar tree on the white stripe symbolizes holiness, eternity, and peace. Adopted in 1943. See **Flag** (picture: Flags of Asia and the Pacific).
Money: *Currency unit*—Lebanese pound. One pound = 100 piastres.

People

Ethnic groups and religion. About 90 per cent of Lebanon's people are Arabs. The Arab population includes about 400,000 Palestinian Arabs, who are refugees from the Arab-Israeli wars. The Palestinians had lived on land that is now part of Israel, Lebanon's neighbour to the south. Other ethnic groups in Lebanon include Armenians, Assyrians, and Kurds.

An estimated 60 per cent of the Lebanese people are Muslims. Almost all the rest are Christians. Among all the world's Arab countries, Lebanon has the highest percentage of Christians. Most of Lebanon's Muslims belong to either the Sunni or Shiite sect of the Muslim faith. A religious group in Lebanon called the *Druse*



Beirut Harbour is Lebanon's chief port facility. It is located at the eastern end of the Mediterranean Sea.

A majestic temple stands among the ruins of the ancient city of Baalbek in Lebanon's Bekaa region. Baalbek was built by the Romans, who took control of Lebanon in 64 B.C.

practises a secret religion related to Islam. The majority of Lebanese Christians are members of the Maronite Church, which is part of the Roman Catholic Church.

Way of life. About four-fifths of Lebanon's people live in urban areas, and about one-fifth live in rural areas. Most wealthy and middle-class Lebanese live in cities, and most are either Christians or Sunni Muslims. The country's poor people—many of whom are Shiah Muslims and Palestinian refugees—live in rural areas or in rundown city areas. Many Palestinian refugees left Lebanon in the 1980's following the Israeli invasion of the south. But some remained in refugee camps in the north.

Traditional Lebanese houses have thick limestone walls and roofs made of orange tiles or earth. This type of house is being rapidly replaced in the cities by modern Western-style houses and apartments.

Most Lebanese wear the same styles of clothing as do people in Western nations. But some rural people still wear traditional Lebanese clothes. Some peasant women, for example, wear colourful long dresses with ankle-length trousers underneath. Some elderly Druse religious men wear woven multicoloured jackets and white headdresses.

Bread, fruit, grains, meat, vegetables, and yoghurt are the chief foods of most Lebanese. The people combine these foods with herbs and spices to create a variety of tasty dishes. Popular beverages in Lebanon include soft drinks, Arabic coffee, wine, beer, and a strong alcoholic drink called *arak,* also spelled *arrack.*

Many Lebanese enjoy the literature, music, and art of both Arabic and Western cultures. Lebanese artists are noted for the beautiful silverware, brassware, jewellery, needlework, and colourful glassware they produce. Popular sports in Lebanon include basketball, soccer, skiing, table tennis, and volleyball. Beaches near the coastal cities are favourite recreation areas.

Education. Lebanese law does not require children to attend school. However, most parents send their children to both primary and secondary school. More than half the schoolchildren in Lebanon go to private schools, which charge tuition, and the rest attend free state schools.

Universities and colleges in Lebanon include the Lebanese University, the Beirut Arab University, Beirut University College, Haigazian College, the American University of Beirut, and St. Joseph University. The American University of Beirut and St. Joseph University were founded by foreign missionaries in the mid-1800's. The American University of Beirut is controlled by a board of trustees in the United States. St. Joseph University is a Roman Catholic institution of the Jesuit religious order.

Land and climate

Lebanon covers 10,400 square kilometres. Its coast extends about 209 kilometres along the Mediterranean Sea. A narrow plain runs along the coast. Farmers grow a variety of fruit on the plain, and most of Lebanon's main cities are there.

The rugged Lebanon Mountains rise east of the coastal plain. They extend, from north to south, down most of the length of the country—a distance of about 160 kilometres. The country's highest peak, Qurnat as Sawda, is in the Lebanon Mountains. It rises 3,083 metres above sea level. Farmers grow fruit on irrigated terraces built on the slopes of the mountains. The upper slopes of the Lebanon Mountains once were covered with the majestic cedars of Lebanon. Most of the trees were cut down in past centuries, but a grove of ancient and beautiful trees survives in the northern mountains. Another range, the Anti-Lebanon Mountains, runs parallel to the Lebanon Mountains along the country's eastern border.

A fertile valley called the *Bekaa* lies between the Lebanon and Anti-Lebanon mountains. The Bekaa ranges from 8 to 16 kilometres in width. It is the site of the ruins of several ancient cities. Much of the Bekaa is used for vegetable farming.

Lebanon's main rivers are the Litani, Nahr Ibrahim, and Orontes. Temperatures in the country's coastal area average about 13° C in January and about 29° C in June. Most of the area is very humid during the summer. Lebanon's inland areas have generally lower average temperatures and less humidity than the coast. About 89 centimetres of rain falls annually along the coast. The mountains receive from 130 to 150 centimetres of rain yearly and much snow during the winter. The Bekaa receives less rain than the mountains.

Economy

The civil war of the mid-1970's and numerous battles that followed seriously damaged Lebanon's economy. The fighting closed many businesses and left many people unemployed. Many businesses and industries continued to function, however, especially the banking system. In addition, much housing construction has taken place in and around Beirut.

Service industries, including trade and finance, rank as Lebanon's chief sources of income. Since the 1820's, Lebanon has served as a major import and export centre of the Middle East. It has also been an important financial centre, with about 100 banks—including branches of foreign banks—in operation. Since the war, trade and finance have decreased in Lebanon, but they remain important to the economy. The country once attracted large numbers of tourists, whose spending contributed greatly to the economy.

Manufacturing and agriculture are also important economic activities in Lebanon. The chief manufactured products include cement, chemicals, electric appliances, furniture, processed foods, and textiles. Fruit—including apples, cherries, grapes, lemons, oranges, and peaches—rank as Lebanon's chief farm products. Potatoes, sugar beet, and other vegetables are also important. Lebanon has had to rebuild many factories and farms that were destroyed during the fighting.

Beirut is Lebanon's chief port. The country's roads are good, but railway services are limited. About 40 daily newspapers are published in the country.

History

Ancient times. Lebanon has been inhabited since prehistoric times. Phoenicians were the first well-known group of people to live there. They probably moved to the region from the south about 3000 B.C. The Phoenicians were sailors, traders, and explorers. They established powerful independent city-states along the coast.

Beginning about 1800 B.C., other foreign powers controlled the Phoenician city-states at different times. They included, in order of rule, Egyptians, Hittites, Assyrians, Babylonians, and Persians. In 332 B.C., the famous Macedonian general Alexander the Great conquered Lebanon. The region came under the control of the Roman Empire in 64 B.C. Ruins of Roman structures still stand. They include huge temples at Baalbek, in the Bekaa; and the town at Bayt Miri, near Beirut. Christianity was introduced into Lebanon about A.D. 325. Many Lebanese became Christians. In 395, the region became part of the Byzantine Empire, a continuation of the Roman Empire.

Muslim rule. In the early A.D. 600's, Muslims from the Arabian Peninsula occupied Lebanon. Islam gradually replaced Christianity along Lebanon's coast. However, Christianity remained strong in the mountains.

Crusaders from Europe invaded Lebanon about 1100. The crusaders were Christians who hoped to regain the nearby Holy Land (Palestine) from the Muslims (see **Crusades**). Christians in the mountains of Lebanon developed friendly relations with the crusaders. In about 1300, the Mameluke dynasty of Egypt drove the last of the crusaders out of Lebanon.

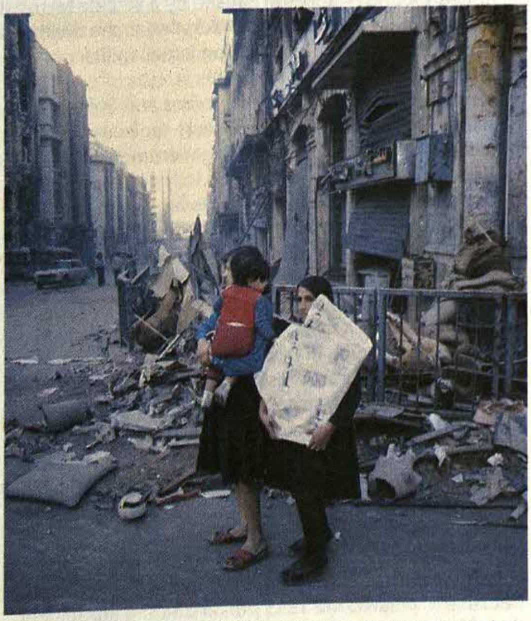
Ottoman rule and independence. Ottoman Turks conquered Lebanon in 1516 and made it part of the Ottoman Empire, which had its capital at Istanbul, in what is now Turkey. But Mount Lebanon, the central part of the country, retained limited self-government under local rulers. The Ottoman Empire ruled Lebanon until World War I (1914-1918), when Great Britain and France occupied the country.

In 1922, France took over Lebanon's political affairs and started to prepare Lebanon for independence. The French united the Christians in Mount Lebanon and the Muslims along the coast under one government. They also helped write Lebanon's Constitution. Lebanon became completely independent in 1943. Christian and Muslim leaders agreed to share power in the government. Following independence, Lebanon prospered more than ever as a centre of trade and finance.

Internal conflicts. Lebanon retained strong ties with the West after it became independent. The country remained peaceful until 1958, when some Lebanese, largely Muslims, rebelled against the government. The rebels opposed government plans for political and military alliances with the West.

In 1969, the activities of the Palestine Liberation Organization (PLO) led to fighting in Lebanon. The PLO—whose chief goal is to establish a Palestinian state for the Arab people of Palestine—raided targets in Israel from bases in southern Lebanon. The Israelis, in turn, attacked PLO forces in Lebanon.

In the 1970's, conflict between Lebanese Christian and Muslim groups flared up. The Christians opposed, and the Muslims supported, the presence of armed PLO members in the country. Also, the country's Muslim population had grown, and the Muslims demanded more power in the government. The PLO supported the Muslims. The Christians opposed Muslim demands for increased power in the government and resented the alliance between the Muslims and the PLO.



Lebanon's civil war caused great damage in many cities. The scene above shows a damaged area in Beirut.

War and terrorism. In 1975, a civil war broke out between Christians and the Muslim-PLO alliance. The fighting killed tens of thousands of people and caused widespread property damage. In the spring of 1976, Syria—which borders Lebanon on the north and east—sent thousands of troops to the country to restore order.

Full-scale fighting in Lebanon ended in late 1976. However, periodic fighting took place between Christians and the Muslim-PLO alliance. Also, both Christian groups and Muslim groups began fighting among themselves. In addition, battles broke out between Christians and Syrian troops in Lebanon.

In June 1982, a large Israeli force invaded Lebanon and drove the PLO forces out of the southern part of the country. The Israelis laid siege to western Beirut, an area where many PLO leaders and troops were stationed. The Israelis demanded that the PLO leave the city and the rest of Lebanon. In late August and early September, the PLO forces left Beirut. Some PLO troops remained in northern Lebanon.

In mid-September, Bashir Gemayel, president-elect of Lebanon and leader of the Lebanese Christian militia, was assassinated. Two days later, members of the Lebanese Christian militia killed hundreds of unarmed Palestinian civilians in refugee camps in the Israeli-occupied part of western Beirut. Israeli forces were aware of what was going on, but chose not to intervene.

The United States, France, and Italy had sent troops to Lebanon to help ensure that the PLO forces could leave the country safely. The troops left Lebanon after the PLO withdrawal. But about two weeks later—following the massacre—the Lebanese government requested that the foreign troops return to help keep order. The United States, France, Italy, and the United Kingdom (UK) then sent troops to Lebanon. Also, the UN peacekeeping force and the Israeli and Syrian troops, who had entered the country earlier, remained in Lebanon.

In late 1983, an explosion caused by a suicide terrorist killed 241 U.S. troops. Similar attacks led to the deaths of 54 French troops, and an attack on Israeli military headquarters in Tyre killed 28 Israelis.

In early February 1984, Druse forces and Shiite Muslims—members of the Shia sect—took control of part of Beirut from the Lebanese government. The United States, the UK, France, and Italy removed their troops from Lebanon following this take-over. In 1985, Israel withdrew its combat troops from all of Lebanon except a Security Zone along the Israeli border.

In 1987, terrorists placed a bomb aboard a military helicopter in which Lebanon's prime minister, Rashid Karami, was travelling. Karami was killed in the explosion. Various groups in Lebanon took foreigners—mostly Americans and Western Europeans—as hostages.

Recent developments. In September 1988, the National Assembly failed to elect a successor to then-president Amin Gemayel. Before he left office, Gemayel, a Christian, appointed another Christian, General Michel Aoun, to replace the Muslim prime minister, Salim al-Huss, and serve until the Assembly chose a new president. Gamayel also appointed a new cabinet. Muslims in Lebanon refused to recognize the interim government because it violated the 1943 power-sharing agreement that the prime minister be a Muslim. As a result, Lebanon had two governments.

On Nov. 5, 1989, members of the Assembly elected a new Christian president, René Mouawad. Mouawad was assassinated on November 22. The Assembly elected Elias Hrawi, also a Christian, president, and approved an agreement that gave more power to the country's Muslim majority. But Aoun refused to recognize the agreement or Hrawi's government. In October 1990, Syrian commandos backed by Hrawi defeated Aoun's forces.

Through the years, much of the fighting in Lebanon took place between private military groups called *militias.* In 1990—as part of a peace plan—the Lebanese government ordered all the militias to withdraw from the Beirut area. The militias did so by the end of 1990. By mid-1991, most private militias had disbanded.

Although the PLO military forces had been driven out of southern Lebanon in 1982, some PLO forces later re-established military bases in the area. In 1991, the PLO and the Palestinians refused to obey an order by the Lebanese government to leave their bases. But the Lebanese Army defeated the Palestinians in a series of battles, and disarmed them.

In 1991 and 1992, all the known surviving American and Western European hostages in Lebanon were released. In 1992, Israel deported to Lebanon 415 Palestinians in retaliation for the killing of a border policeman. Despite international criticism, the deportees were not accepted by Lebanon and were not readmitted by Israel. On Feb. 1, 1993, the Israeli government agreed to accept the return of 100 of the deportees and to allow the remainder to return home within a year.

In July 1993, thousands of villagers fled from southern Lebanon after Israeli attacks on Hezbollah guerrilla bases. Israel said its action was in retaliation to attacks on settlements in northern Israel.

Hopes for peace in the Middle East improved in September 1993, when Israeli prime minister Yitzhak Rabin and PLO chairman Yasir Arafat signed a peace accord. The agreement granted limited Palestinian self-rule in the West Bank and the Gaza Strip.

Related articles in ***World Book*** include:

Arab League
Beirut
Druses
Phoenicia
Tripoli
Tyre

Lebowa was one of ten *homelands* (nation states) set up by the South African government under the former policy of *apartheid* (enforced racial separation). It was home to about 2.6 million Pedi people, who speak North Sotho as their first language. All ten homelands were reincorporated into South Africa on April 27, 1994. Lebowa became part of the Northern Transvaal Province.

People with a culture like that of the Pedi have lived in the Northern Transvaal since the A.D. 200's. In the mid-1990's, the area once covered by Lebowa continued to suffer some of the damaging effects of the government's former homelands policy. These included unemployment and a shortage of adequate housing, food, medical care, and schools.

See also **Apartheid; South Africa, History of.**

Le Carré, John (1931-　　), is the pen name of David John Moore Cornwell, an English novelist. He is known chiefly for his riveting spy stories, which are both realistic and unromantic. Most of Le Carre's spies are lower-level British civil servants who are involved with the routine affairs and rivalries of a government bureaucracy and with the confusions of cloak-and-dagger intrigue.

In *The Spy Who Came in from the Cold* (1963) and *The Looking Glass War* (1965), le Carré created central characters who are manipulated by their superiors and partially fail in their assignments. Le Carré wrote three novels about British secret service agent George Smiley—*Tinker, Tailor, Soldier, Spy* (1974), *The Honourable Schoolboy* (1977), and *Smiley's People* (1979). Smiley also features in the suspense novels *Call for the Dead* (1961) and *A Murder of Quality* (1962). Le Carré's other novels include *A Small Town in Germany* (1963), *The Little Drummer Girl* (1983), and *A Perfect Spy* (1986).

Le Carré was born in Poole. He served briefly as a British intelligence officer in Austria shortly after World War II. From 1961 to 1964, he was an officer in the British Foreign Service.

Lechenaultias, also spelled *Leschenaultias,* are a group of about 20 kinds of plants that grow in Western Australia. One species also grows in Malaysia. They are small, healthy undershrubs or *prostrate* (lying) plants with fairly large, attractive flowers. The best-known species, *L. biloba,* is an upright plant a few centimetres high with brilliant blue flowers. Another, *L. formosa,* has bright red, maroon, or yellow flowers. Both kinds of lechenaultias grow on the sand plains.

Scientific classification. Lechenaultias are members of the family Goodeniaceae. They make up the genus *Lechenaultia.*

Lecithin. See Soybean (Soy oil).

Lecky, William Edward Hartpole (1838-1903), an Irish historian and philosopher, was one of the greatest historians of his day. His 12-volume *History of England in the Eighteenth Century* took him 19 years to write. It won him great praise for its clarity, reliability, and impartiality. His other works include *Leaders of Public Opinion in Ireland* (1861), *Rationalism in Europe* (1865), and *History of European Morals* (1869). Lecky was born near Dublin and studied at Dublin University.

Le Corbusier (1887-1965) was the professional name of Charles Édouard Jeanneret-Gris, often considered the most important architect of the 1900's. He demonstrated his mastery of design in a series of residences during the 1920's. They included the villa "Les Terraces" (1926-1927) near Paris and the Villa Savoye (1929-1931) in Poissy, France. These houses are examples of what came to be known as the *International Style* of architecture.

The International Style was identified by white cubic shapes and the avoidance of ornament. Such characteristics, however, are not central to Le Corbusier's work. In his "Five Points" (1926), a series of diagrams, he made an apparently simple but imaginative connection between theory and practice. He used certain characteristics of reinforced concrete construction to enclose and use space in new ways.

Le Corbusier's five points called for the use of (1) *pilotis* (columns that raise a building above the ground); (2) flat roofs with gardens; (3) the *free plan* (independence of the structural frame from the walls); (4) the *free façade* (no structural limitation on window placement); and (5) a continuous horizontal window (one aspect of the free façade).

Le Corbusier's new approach to a structure's form and use was part of what he called the New Spirit that humanity sets free for humanity's own full development. This spirit—especially as it appeared in the arts—was discussed in a magazine called *l'Esprit Nouveau* (1920-1925), edited by Le Corbusier and the French painter Amedée Ozenfant. Le Corbusier's essays on architecture were collected in his major book, *Towards a New Architecture* (1923).

During the 1930's and 1940's, Le Corbusier built few buildings. His interest in city planning became dominant. He proposed the demolition of urban areas and their rebuilding according to his ideas on planning and architecture. His major achievement in city planning was his plan and design for the principal buildings of the new city of Chandigarh, India, in the 1950's.

In his final buildings, Le Corbusier continued to demonstrate his understanding for architectural form interacting with functional and social conditions. These works include the Unité d'Habitation, a block of flats in Marseille, France (1947-1952); the pilgrimage chapel in Ronchamp, France (1950-1955); the Convent of La Tourette near Lyon, France (1955-1960); and the Carpenter Center for the Visual Arts at Harvard University in Cambridge, Massachusetts, U.S.A. (1961-1963).

Le Corbusier was born in La Chaux-de-Fonds, Switzerland, and settled in Paris in 1917. He received most of his architectural training by travelling in Europe and by working under the architects Auguste Perret in Paris and Peter Behrens in Berlin.

For a picture of Le Corbusier's work, see **Architecture** (Modern architecture).

Lederberg, Joshua (1925-), an American geneticist, shared the 1958 Nobel Prize for physiology or medicine. He received the award "for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria." Lederberg was born in Montclair, New Jersey.

Lee, Harper (1926-), is an American author who became famous with her only novel, *To Kill a Mockingbird* (1960). The book won the 1961 Pulitzer Prize for fiction.

The plot centres on a small-town lawyer in Alabama who defends a young black falsely accused of raping a white woman. The story is told by the lawyer's young daughter. The appeal of the novel lies in the author's ability to weave together the vivid eccentric characters of a small Southern town, the observations of a sensitive child, and a plea for social justice.

Nelle Harper Lee was born in Monroeville, Alabama. She grew up in the state and attended the University of Alabama.

Lee, Henry (1756-1818), was a noted American cavalry leader during the American Revolution (1775-1783). His success as a scout and in making lightning raids won him the nickname of "Light-Horse Harry." After the war, Lee became a leading statesman.

Lee became a captain in the Virginia cavalry in 1776, and the next year his company joined George Washington's army. In 1778, Lee was made a major in charge of a force of cavalry and infantry that became known as "Lee's Legion." In 1779, he led the group in a daring raid on the British post at Paulus Hook (now Jersey City, New Jersey). In 1780, Lee became a lieutenant colonel and was assigned to fight under General Nathanael Greene in the south.

After the war, Lee entered the Virginia House of Delegates. He served in the Congress of the Confederation from 1785 until 1788. Lee served as governor of Virginia

Detail of an oil painting on canvas (1782) by Charles Willson Peale

"Light-Horse Harry" Lee was a brave and daring cavalry leader in the American Army during the American Revolution.

from 1791 to 1794, and commanded the troops that President Washington sent in 1794 to end the Whiskey Rebellion (see **Whiskey Rebellion**). Lee was a member of the Federalist Party. From 1799 to 1801, he served as a member of Congress. He wrote the famous epitaph of George Washington, "First in war, first in peace, and first in the hearts of his countrymen."

Lee fell deeply into debt in later years, and was imprisoned in 1808 and 1809. During this time, he wrote his *Memoirs of the War in the Southern Department of the United States.* In 1812, he was injured while trying to protect a friend from rioters in Baltimore. He never fully recovered from this injury.

Lee was born on Jan. 29, 1756, at "Leesylvania," Prince William County, Virginia. He graduated from the College of New Jersey (now Princeton University) in 1773.

Lee, Laurie (1914-), a British poet and author, won wide acclaim with his book *Cider with Rosie* (1959), a sensitive, enthralling account of his childhood in Gloucestershire. Lee's other works include books of poetry—*The Sun My Monument* (1944), *The Bloom of Candles* (1947), *My Many-Coated Man* (1955), and *Selected Poems* (1983). He also wrote *The Voyage of Magellan* (1948), *A Rose for Winter* (1955), *The Firstborn* (1964), *As I Walked Out One Midsummer Morning* (1969), and *I Can't Stay Long* (1976).

Lee, Manfred B. See **Queen, Ellery.**

Lee, Robert Edward (1807-1870), was a great general who commanded the Confederate Army in the American Civil War. Lee's fame rests on his military achievements as Confederate commander in the face of overwhelming odds, and on his outstanding personal character.

Robert E. Lee was born in Stratford Hall, near Montross, Virginia, U.S.A., on Jan. 19, 1807. He graduated from the United States Military Academy at West Point with high honours in 1829, and he was commissioned as a second lieutenant in the Corps of Engineers.

When war broke out between the United States and Mexico in 1846, the army sent Lee to Texas to serve as assistant engineer under General John E. Wool.

In 1855, Lee became a lieutenant colonel of cavalry and was assigned to duty on the Texas frontier. There he helped protect settlers from attacks by the Apache and Comanche Indians. When Texas seceded from the Union in 1861, Lee was recalled to Washington, D.C., to wait for further orders.

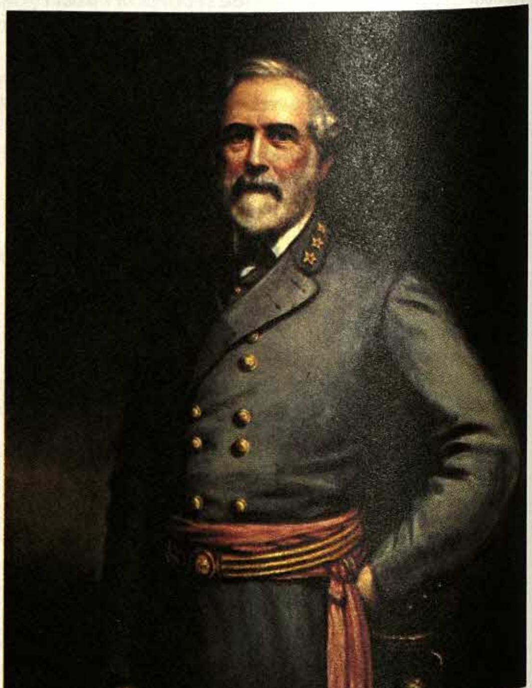
Unlike many Southerners, Lee did not believe in slavery and did not favour secession. He felt that slavery had an evil effect on masters as well as slaves. Long before the war, he had freed the few slaves whom he had inherited. Lee greatly admired George Washington, and hated the thought of a divided nation. But he came to feel that his state was protecting the very liberty, freedom, and legal principles for which Washington had fought. He was willing to leave the Union, as Washington had left the British Empire, to fight what the South regarded as a second war of independence.

In the Confederate Army, Lee served in Richmond, Virginia, as military adviser to Confederate President Jefferson Davis, and in May 1861, was appointed a full general.

In 1862, Lee took command of a force which he called the Army of Northern Virginia.

From his first day of command, Lee faced what looked like an impossible task. Union General George B. McClellan had approached within 11 kilometres of Richmond with 100,000 men. In a series of engagements known as the Battles of the Seven Days, Lee forced McClellan to retreat.

In 1862, Lee won a major victory over General John Pope in the second Battle of Bull Run (Manassas). After an unsuccessful attempt to invade Maryland the same year, Lee returned to Virginia to reorganize his army.



Oil painting on canvas (1904) by Theodore Pine; Lee Chapel, Washington and Lee University, Lexington, Va.

General Robert E. Lee commanded the Confederate Army in the American Civil War. He is one of the nation's greatest heroes.

General Ambrose E. Burnside led an attack against Lee in December 1862, at Fredericksburg, Virginia. Lee's troops badly defeated the Union forces. But Lee could not take advantage of his victory.

General Joseph Hooker, who had taken over from Burnside, attacked Lee at Chancellorsville in the spring of 1863. The Confederate forces won a spectacular victory.

Lee moved into Pennsylvania and encountered the Northern army now under General George G. Meade, at Gettysburg. Bitter fighting continued for three days, from July 1 to 3, 1863. The Confederates met defeat in what proved to be a turning point of the war. Lee insisted on taking the blame for the failure.

In the spring of 1864, Lee first faced General Ulysses S. Grant. In a series of fierce and bloody battles called the Wilderness campaign, Grant pounded the Army of Northern Virginia to pieces with his larger forces and guns. Lee held out for nine months in the siege of Petersburg, but his tired, hungry men finally had to retreat. Early in 1865, Lee was made general in chief of all the Confederate armies. Richmond fell in April 1865, and Lee's ragged army retreated westward. Northern forces cut off and surrounded Lee's troops at Appomattox Court House, Virginia, where Lee surrendered to Grant on April 9, 1865.

See also **American Civil War; Lee, Henry.**

Lee, Tsung Dao (1926-), shared the 1957 Nobel Prize for physics with Chen Ning Yang. They proposed that the "conservation of parity," a basic principle of nuclear physics, did not hold true in some cases (see **Parity** [in physics]). Lee has also concentrated on field theory, astrophysics, and hydrodynamics.

Lee was born in Shanghai, China. He was educated at Chinese universities and the University of Chicago, where he received a Doctor of Philosophy degree in 1950.

Lee Kuan Yew (1923-) was prime minister of Singapore from 1959 until 1990. Under Lee's rule, Singapore became one of the most prosperous countries in Asia. His government exercised strong control over the nation's economy and political system. In 1990, Lee resigned as prime minister and was succeeded by Goh Chok Tong. But Lee remained an important political figure as head of his political party and as a senior minister in Goh Chok's cabinet.

Lee Kuan Yew

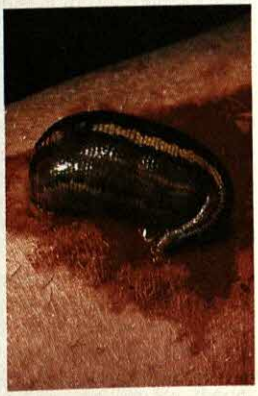
Lee was born in Singapore. He attended Raffles College in Singapore, and, in 1949, graduated from Cambridge University in England with a law degree. Lee returned to Singapore in 1951, and became a labour lawyer. He helped found the People's Action Party, Singapore's dominant political party, in 1954. Lee became prime minister in 1959, when Singapore gained self-government for its internal affairs. He remained as prime minister from 1963 to 1965, while Singapore was part of the Federation of Malaysia. Lee continued in that position after Singapore became an independent country in 1965.

Lee Teng-hui (1923-) became president of the Republic of China (Taiwan) and chairman of the country's Nationalist Party in 1988. Lee, then vice president, succeeded Chiang Ching-kuo, who had died. In 1990, he was elected president. As president, Lee has continued Chiang's programme of democratic reform and has increased Taiwan's contacts with other countries. He has appointed young, educated, reform-minded people to top government and party positions.

Lee Teng-hui

Lee was born in Sanchih, near the city of Taipei. He attended universities in Japan, Taiwan, and the United States. He received a doctoral degree in agricultural economics from Cornell University in the United States in 1968. He taught at National Taiwan University before becoming an agricultural specialist for the Taiwanese government. In 1972, he became a minister of state. He was appointed mayor of Taipei in 1978, and provincial governor in Taiwan in 1981. In 1984, President Chiang Ching-kuo chose him as his vice president.

Leech is a worm that has a disclike sucker at each end. It has a mouth centered in the front sucker, and may also have small teeth. Some leeches live as parasites, sucking on the blood and tissue of other animals for nourishment. Others feed on decaying animal and plant material. Parasitic leeches attach to their victim with the front sucker, make a wound, and then suck out blood. Bloodsucking leeches produce a liquid containing a chemical substance called *hirudin.* Hirudin prevents the blood from thickening and makes it easier for the leech to suck the blood. Doctors once used what they called *medicinal leeches* to remove blood from patients. The leeches were used to help heal bruises and cure diseases. Doctors seldom recommend the use of medicinal leeches today.



A parasitic leech sucks human blood through a mouth centred in a disclike front sucker. The leech has a similar sucker on the other end of its body.

A leech's body is made up of a series of ringlike *segments* (parts). Leeches may be from 2 to 20 centimetres long and can stretch or shorten their bodies. They are black, red, or brown and may have stripes or spots. They have clusters of light-sensitive cells called "eyes" near the front end. They are also sensitive to touch, temperature, and drying. A leech contains both male and female reproductive organs.

Leeds is one of the finest provincial centres in the United Kingdom. It has modern office blocks, residential flats, and an up-to-date road system.

Leeches live in damp places such as jungles, or in the shallow water of streams, lakes, or oceans.

Scientific classification. Leeches make up the class Hirudinea of the phylum Annelida. Members of the genus *Haemadipsa* are the troublesome land leeches of the jungle. The medicinal leech is *Hirudo medicinalis.*

See also **Worm** (Segmented worms).

Leechee. See **Litchi.**

Leeds (pop. 674,400) is a metropolitan district in West Yorkshire, England, centred on the city of Leeds. Extensive rail and motorway connections and an airport make Leeds an important industrial city. A long tradition of coal mining in the area ended in 1992. Main industries today include manufacturing, engineering, printing, packaging, and financial and legal services.

Prestigious media, academic, and medical institutions are based in Leeds. The city is a cultural centre for northern England. Leeds is the home of the English National Opera (North), the West Yorkshire Playhouse, the Henry Moore Institute, and the Leeds International Piano Competition. The architecture of the city centre is largely Victorian and includes the Corn Exchange, the Victoria Quarter, and Kirkgate Markets.

Leek is a vegetable related to the onion. The leek plant has many flat leaves that join together at their base to form a thick stem. The stem measures 2.5 to 5 centimetres wide and 10 to 20 centimetres long. The stem is the edible part of the plant, and it has a mild, onionlike flavour. It is eaten raw, or it is cooked or used as a seasoning for other foods.

Leeks are *biennial* plants—that is, they live for two years. The plants are grown from seeds, and they require a long growing season. Leek seeds are generally planted in a greenhouse or hotbed in the early spring. In late spring, the seedlings are transplanted to a field or garden. Rich, fertile soil is packed around the stem.

Leeks probably originated in the eastern Mediterranean region. Today, they are popular in northern European countries. The leek is the national plant of Wales.

Scientific classification. The leek belongs to the Amaryllis family, Amaryllidaceae. It is classified as *Allium porrum.*

Leeuwenhoek, Anton van (1632-1723), a Dutch amateur scientist, was one of the first people to record observations of microscopic life. He provided the first clear descriptions of bacteria.

Leeuwenhoek was born in Delft, the Netherlands. His simply constructed microscopes were among the most powerful of his day.

In 1674, Leeuwenhoek concluded that the moving objects he viewed through his microscopes were tiny animals. He called the microorganisms *animalcules.* They included what are now known as bacteria, protozoa, and rotifers.

Leeuwenhoek hoped that his discovery of the animalcules would disprove the widely believed theory of *spontaneous generation.* This theory held that lower forms of life, such as worms and lice, originated from nonliving matter. To challenge this belief, Leeuwenhoek studied the sperm of several kinds of animals as well as

The leek, a variety of onion, has a slender white bulb at the base of the leaves. A purple flower cluster blooms in the spring.

the life cycles of mites, lice, and fleas. His studies contributed to the abandonment of the theory of spontaneous generation in the mid-1800's.

See also **Medicine** (History).

Leeward Islands lie in the West Indies. They stretch from Puerto Rico to the Windward Islands, and form part of the Lesser Antilles. For the location of the Leeward Islands, see **West Indies** (map). The islands were named *Leeward* because they appeared to be sheltered from the trade winds. The word *lee* refers to the side of a boat that is sheltered from the wind.

The Leeward Islands include about 15 islands and many islets. They have an area of 3,994 square kilometres and a population of about 678,000. The Leeward group includes two independent countries: Antigua and Barbuda, and St. Christopher and Nevis. The Leeward group also includes Anguilla, the British Virgin Islands, and Montserrat, which are dependencies of the United Kingdom; St. Eustatius, Saba, and St. Martin, which are Dutch territories; Guadeloupe, a French overseas department; and the Virgin Islands of the United States, a United States territory.

The climate varies, but it is generally dry and pleasant. Most of the people are farmers or fruit growers. The main products are tobacco, cotton, onions, coconuts, tomatoes, limes, pineapples, sugar, and dairy products.

See also **British West Indies; Guadeloupe; Virgin Islands; West Indies; Windward Islands.**

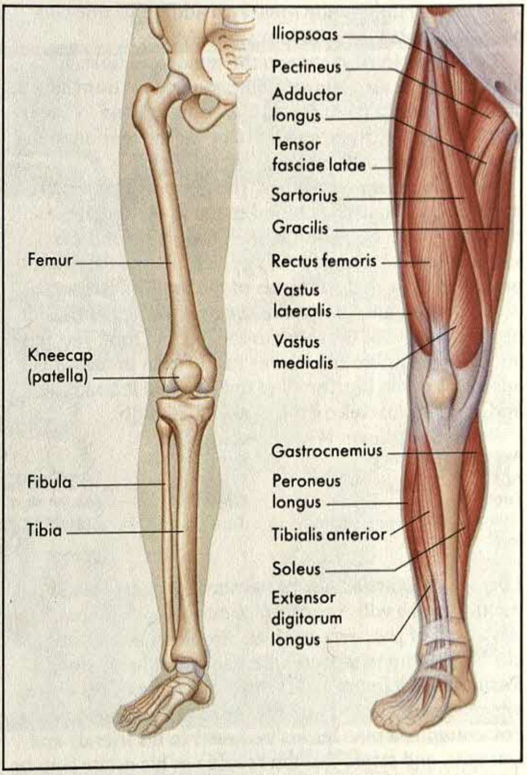
Le Fanu, Sheridan (1814-1873), was an Irish writer of short stories, novels, and poetry. He is well known for his ghost stories. His *Torlogh O'Brien* (1846) is often considered to be among the best of Irish historical novels.

Joseph Sheridan Le Fanu was born in Dublin and educated at Trinity College. He qualified as a barrister, but became a journalist. He published stories of the supernatural in *The Dublin University Magazine,* which he later bought and edited. His books include *The House by the Churchyard* (1863), *Uncle Silas* (1864), and *In a Glass Darkly* (1872).

Left-handedness. See **Handwriting.**

Left wing is a term which means a radical party or branch of a political group. The term originated in the first French legislature after the French Revolution. The conservative representatives were seated to the right of the speaker, and the more radical deputies were seated to the left. Later, people throughout the world used the terms *left* and *right* to denote two opposing political beliefs, radical egalitarianism and conservatism. In general, the left has valued equality more highly than individual freedom, while the right has valued liberty more highly than equality. Today, the left wing is often identified with socialism or Communism.

Leg is the limb that supports the body of a human being or animal. Properly, it is only that section of the lower limb between the ankle and the knee. The part of the limb between the knee and hip is called the *thigh.* In human beings, the thigh contains the *femur,* the longest, strongest bone of the body. The femur meets the hipbone at the hip joint. This is a ball-and-socket joint that allows a person to move the limb freely, but also provides the stability needed to bear the weight of the body. See **Hip.**



The leg contains large, strong bones, *left,* which support the weight of the body. Powerful leg muscles, *right,* permit such movements as walking, jumping, climbing, and kicking.

The thigh. Muscles attached to the bones by *tendons* (strong cords of tissue) make it possible for people to move their limbs. The front of the thigh consists of a four-parted muscle, the *quadriceps femoris.* This muscle allows a person to straighten the limb at the knee, and to bend the thigh at the hips. Three long muscles, called the *hamstring muscles,* allow a person to bend the knee and straighten the thigh. The length of the hamstrings varies considerably among people. In some people, the hamstrings will not stretch enough to allow the person to touch the toes with the fingers. In others, the hamstrings are long, allowing the person to touch the floor with the palms or to do a high kick. The tendons of these muscles connect with the leg bones and can easily be felt on either side of the leg behind the knee. The quadriceps femoris and hamstring muscles are chiefly used for walking, running, kicking, and climbing.

The leg, or lower part of the limb, contains two bones. These are the *tibia* (shinbone), which can be felt close to the middle front section of the leg, and the *fibula* in the muscles of the side of the leg.

Seven muscles make up the *calf* (fleshy part of the back of the leg). The *gastrocnemius* is the most prominent. These muscles allow a person to bend the toes and to raise the body on the balls of the feet. The *tendo calcaneus,* or *Achilles' tendon,* connects the gastrocnemius and two other calf muscles to the heel bone. This tendon forms the prominent ridge on the back of the leg, extending upward from the heel to the lower calf. Four muscles on the front of the leg bend the foot upward and straighten the toes. Two additional muscles near the fibula bend the foot sideways.

The knee joint, between the femur and tibia, acts like a hinge. It also allows a little movement from side to side. The *patella* (kneecap) is a triangular bone in front of the knee joint. It acts as a pulley for the tendon of the quadriceps femoris muscle.

Blood and nerve supply. The *femoral artery* is the main artery that carries blood to the lower leg. It runs down the front of the thigh, then travels behind the knee, where it becomes the *popliteal artery.* Finally, it branches to form the arteries of the leg. The largest nerve of the entire body, the *sciatic nerve,* extends down the back of the thigh to the leg and foot. The sciatic nerve supplies the nerves for the skin of the foot and most of the leg, for all of the foot and leg muscles, and for the muscles on the back of the thigh.

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Human body (Trans-Vision)
Joint
Knee
Ligament
Muscle
Tendon

Legacy is a disposition of personal property made by the terms of a will. *Specific legacies* are gifts of particular pieces of property, such as jewellery, books, or clothing. *General legacies* are usually sums of money. *Residual legacies* are what remains of a person's estate after the specific and general legacies have been paid. For example, a man leaves bequests to his friends and servants, and states that the residue of his estate is to be divided between his wife and son (see **Will**).

Before any legacies are given out, the debts of the dead person must be paid. Next, the specific legacies are paid out, and then the general legacies. The residual legatees divide what remains. Sometimes a person's estate is exhausted in paying claims and the legatees named in the will receive nothing.

Legal age. See **Minor.**

Legal aid is a scheme under which people may, in certain circumstances, claim money from the government in order to pay for a lawyer to represent them in court.

In some countries, legal aid is available for most types of legal proceedings, both criminal and civil, if the applicant has little money. In other countries, assistance may be limited to defence costs for serious criminal cases only. The United Kingdom provides aid for a wide range of proceedings. But aid is not available for libel actions, or for cases before tribunals where proceedings are informal. In all countries, applicants for legal aid must indicate the merits of their case, and the likely success of the case is assessed by a panel of experts.

In most legal systems, people with very low incomes can obtain free legal advice and representation. Those with higher incomes, but still below a certain limit, are required to pay part of the legal costs. In some countries, such as Australia, the legal aid system employs lawyers to represent people entitled to legal aid. In others, clients employ lawyers privately but have their costs paid for them.

Legal blindness. See **Blindness.**

Legal holiday. See **Holiday.**

Le Gallienne, Dorian (1915-1963), is regarded by many critics as the most distinguished composer Australia has ever produced. He was born in Melbourne and studied at the University of Melbourne and the Royal College of Music in London. In 1951, he won a scholarship and spent two years in England studying with Gordon Jacob. His works include a symphony, a sinfonietta, and other orchestral works as well as chamber music and songs.

Legation is a diplomatic mission from one nation to another that is headed by a minister. Ministers rank below ambassadors. Before World War II (1939-1945), most nations maintained legations abroad rather than embassies. Since then, many countries have replaced their legations with embassies. See also **Ambassador; Minister.**

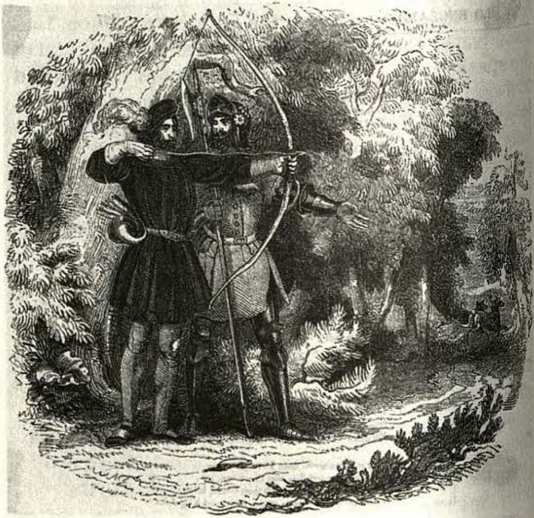
Legazpi, Miguel López de (1510?-1572), a Spanish explorer, claimed the islands of the Philippines for Spain in 1566. He served as the first Spanish governor of the Philippines from 1566 until his death.

He was born in Zumarraga in Spain of a Basque noble family. In 1545, he went to Mexico where he became a colonial official.

In 1564, King Philip II sent him to the Philippine islands. The Spanish explorer Ferdinand Magellan had visited the islands in 1521 but no European settlement had been established. In 1566, Legazpi established a Spanish settlement on the site of the modern Cebu City. In 1571, he went north and established Manila as a Spanish settlement, after deposing the local ruler. He put down any Filipinos who refused to accept Spanish rule. He rewarded his followers with land grants called *encomiendas* for their service to the Spanish crown.

Legend. See **Map** (Map legends).

Legend is a popular type of folk story. In some ways, legends resemble *myths,* another type of folk story. But myths, most of which describe events of long ago, deal with such religious subjects as the birth and death of gods and goddesses. Most legends tell about recognizable people, places, and events of more recent times. Some legends are based on real people or events, but many concern imaginary characters.



Robin Hood of Sherwood Forest is a legendary hero of medieval England who robbed the rich and gave to the poor.

Every society has some legends, and most of them reflect the attitudes and ideals of the group that created them. The heroes of legends have qualities that their society considered admirable. For example, many legends tell about Richard the Lionheart, King of England in the 1100's. Such legends emphasize the courage and fairness of the king. On the other hand, evil characters in legends show cowardice or greed, which society regards as undesirable.

The majority of societies have both local and national legends. Local legends tell about heroes of a particular ethnic group, occupation, or region. For example, Robin Hood is an English legendary hero of the 1300's. National legends are shared by an entire people. Many British men, women, and children take pride in the achievements described in the tales of King Arthur and his knights of the Round Table.

See also **Folklore** and its list of *Related articles.*

Legendre, Adrien Marie (1752-1833), a French mathematician, wrote *Elements of Geometry* (1794), which influenced the teaching of geometry in schools. It made considerable use of numbers and of algebra, unlike traditional geometry texts. He also helped set up the metric system, and worked on the theory of numbers, elliptic functions, differential equations, and trigonometric tables (see **Metric system**). Legendre was born in Toulouse, France.

Léger, Alexis. See **Perse, Saint-John.**

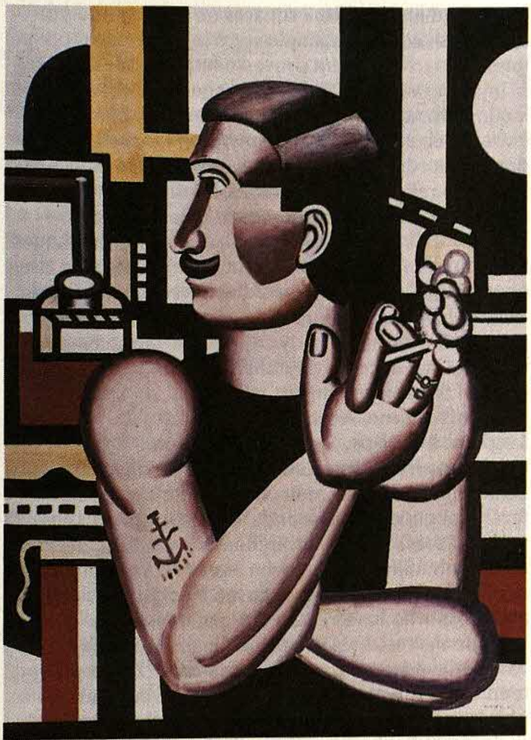
Léger, Fernand (1881-1955), was a French artist who developed a distinctive style that reflects modern technology. Léger's works feature cylindrical and tubular shapes that have a machinelike quality. Some of his paintings are more abstract than others, but objects and figures can be identified in most of them. Léger's subjects include such mechanical devices as machine cogs and railway wheels and such human subjects as construction workers and mechanics. His painting *Three Women* is reproduced in *World Book* in the **Painting** article.

Léger was born in Argentan, near Alençon. His early paintings show the influence of the French artist Paul Cézanne and of the cubist movement. Beginning in the early 1940's, Léger enclosed his forms with heavy black lines that gave his pictures a posterlike simplicity. In some later pictures, he painted outlined figures and objects over abstract colour patterns.

Léger, Jules (1913-1980), was governor general of Canada from 1974 to 1979. During his term, Léger devoted much time to strengthening relations between French- and English-speaking Canadians. He also worked to promote Canadian culture. Despite suffering a stroke early in his term, Léger travelled widely to meet with cultural and volunteer organizations.

Léger was born in St.-Anicet, Quebec, near Montreal. He studied law at the University of Montreal and literature at the University of Paris. Léger then taught diplomatic history at the University of Ottawa during the late 1930's and joined the Canadian foreign service in 1940. He became the Canadian ambassador to Mexico in 1953, and later served as ambassador to Italy, France, Belgium, and Luxembourg. Léger was undersecretary of external affairs from 1954 to 1958 and undersecretary of state from 1968 to 1973.

Legerdemain. See **Magician** (Sleight of hand).



Detail of oil painting on canvas (1920); Musée Nationale Fernand Léger, Biot, France

Fernand Léger's *The Mechanic* shows how the artist used cylindrical forms to express his fascination with modern machines.

Leghorn (pop. 175,371) is a major Italian seaport. Its Italian name is Livorno. Leghorn lies on the shore of the Ligurian Sea, about 100 kilometres southwest of Florence (see **Italy** [political map]). It is an important industrial city, with steelworks, glass factories, and car plants. Leghorn hats, made from wheat straw, and coral ornaments are exported. The city's other exports include marble, olive oil, boric acid, silk, and wine. Leghorn has many canals.

The most interesting of its public buildings include the cathedral, a synagogue, the Academy of Sciences, and the naval academy. The *Tower of the Sculptured Lion,* a leading landmark, is a relic of the days when the city was a free port.

Leghorn was a little fishing village when the Florentines took it in 1421. It has grown steadily in importance and prosperity. The sulphur springs and sea bathing attract many visitors.

Legion was a division of the Roman army. Its size varied from about 4,000 to 6,000 men during different periods of Roman history. After Rome became an empire, a general chosen by the emperor commanded each legion. Six young commissioned officers called *military tribunes* served under him. But the 60 veteran noncommissioned officers called *centurions* were the most effective and important leaders. Each centurion led a *century* (a unit of about 100 men).

Before the late 100's B.C., legions were divided into *maniples* of 120 men each. On the battlefield, a legion formed into three rows of maniples, with the maniples positioned like the black squares on a draughtboard. Spaces as wide as a maniple were left between the maniples. This arrangement proved effective against masses of invading warriors and against enemy forces advancing in tight ranks. The men in the front row of maniples hurled their spears at the enemy, then attacked with drawn swords. The second row charged into the empty spaces to relieve their comrades. Finally, the third row advanced with thrusting spears to secure victory.

In 107 B.C., a general named Gaius Marius rearranged the legions into *cohorts* of about 400 men each. He also opened the legions to men of the lower classes, and an army of loyal, professional soldiers soon developed (see **Marius, Gaius**). In the early days of the Roman Empire, the army had nearly 30 legions. These formed the backbone of the Roman army.

See also **Rome, Ancient** (The army).

Legion, Foreign. See **Foreign Legion.**

Legionnaires' disease is an infection that most commonly occurs as pneumonia, with symptoms of fever, cough, chest pain, and difficult breathing. Legionnaires' disease occurs throughout the world. It most commonly afflicts people who already have another illness, such as lung disease caused by cigarette smoking, and those who have received organ transplants.

Legionnaires' disease was first identified in July 1976, when an epidemic of pneumonia struck 221 people attending an American Legion convention in a Philadelphia hotel. Thirty-four of those stricken died. Doctors did not know what caused the illness, which they named Legionnaires' disease.

In January 1977, scientists discovered the cause of the pneumonia, a bacterium later named *Legionella pneumophila.* This bacterium is unusual because it can invade white blood cells and multiply within them. White blood cells normally defend against infections. The bacterium commonly occurs in water supplies. Many outbreaks of Legionnaires' disease in hotels, hospitals, and homes have been linked to the presence of the bacteria in the drinking water.

Doctors diagnose Legionnaires' disease by testing for antibodies to the bacterium in the blood or by detecting the bacterium in the mucus coughed up from the lungs. The disease can be effectively treated with specific antibiotics, including erythromycin and rifampin. Legionnaires' disease bacteria in water supplies may be killed by heating the water to high temperatures, treating it with chlorine, or exposing it to ultraviolet light.

Legislative Assembly. See **Canada, Government of** (Provincial and territorial governments); **French Revolution** (The Legislative Assembly).

Legislature is the lawmaking branch of a government. In Australia, Canada, India, New Zealand, and the United Kingdom (UK), the national legislature is called the *Parliament.* In the United States, it is called the *Congress.* In Ireland, it is called the *Oireachtas,* and in Japan, the *Diet.* Most legislatures have the power to pass laws (sometimes called *statutes*), which all citizens must obey. Sometimes legislatures have more authority than a government's executive head, and can supervise and regulate the leader's activities.

In parliamentary forms of government, as in Canada and the UK, the legislature determines the appointment of the prime minister and the cabinet. The ministry can remain in office only so long as it has the support of a majority in the legislature. In presidential systems, as in the United States, the chief executive is elected for a definite number of years. The chief executive holds office for that length of time even without the support of a majority in the legislature.

Most legislatures today are divided into two separate groups, called houses or chambers. A legislature of two chambers is called a *bicameral* legislature. In the UK, these two chambers are the *House of Lords* and the *House of Commons.* In Australia and the United States, they are the *Senate* and the *House of Representatives.* In India, they are the *Lok Sabha* (or House of the People) and the *Rajya Sabha* (or House of the States). In most two-house legislatures, both houses must approve a bill before it becomes a law. But in the UK, only the approval of the House of Commons is necessary to pass any law relating to money matters.

In the U.S. Senate, each state, regardless of population, is equally represented. But members of the U.S. House of Representatives are divided among the states according to their population. Most state legislatures resemble the national legislature in organization and method of operating. Each state in India has its own legislative assembly responsible for such matters as agriculture and education. Some states have one-house legislative assemblies. A one-house body is known as a *unicameral* legislature.

Most national legislatures hold a regular session each year. Special sessions may be called to meet problems that come up between the regular sessions.

The members of legislatures are elected to office for a varying number of years. Members of the UK House of Commons are elected to five-year terms. In India, the Lok Sabha's 545 members are elected for five-year terms. One-third of the members of the Rajya Sabha are chosen every two years for a fixed six-year term.

In cities, the legislature is usually called the *board of aldermen, common council,* or *city council.* In some cities, the legislature is called the *commission.* Laws passed by city legislatures are usually called *ordinances.*

Related articles in *World Book* include:

Address, Forms of
Bill
Committee of the whole
Duma
House of Burgesses
House of Commons
House of Lords
Law
Lobbying
Local government
Mace
Parliament
Parliamentary procedure
Proportional representation
Quorum
Repeal
Senate
Sergeant at arms
Speaker
Veto

Le Guin, Ursula (1929-   ), is an American author of science fiction for adults and children. Many of Le Guin's novels for adults involve conflicts between individuals and society. Two of her finest adult novels are *The Left Hand of Darkness* (1969) and *The Dispossessed* (1974). Both works feature highly imaginative descriptions of civilizations on distant planets. Her other adult novels include *The Lathe of Heaven* (1971) and *The Word for World Is Forest* (1976). Many of her short stories were collected in *The Wind's Twelve Quarters* (1975) and *Orsinian Tales* (1976). Her essays on science fiction and fantasy were published in *Language of the Night* (1979).

Le Guin's most popular work for children is the *Earth-*

sea trilogy. It consists of—*A Wizard of Earthsea* (1968), *The Tombs of Atuan* (1971), and *The Farthest Shore* (1972). The three books describe the adventures of Ged, who, as a boy and adult, struggles against the forces of evil in the imaginary Land of Earthsea. She continued the story in *Tehanu: The Last Book of Earthsea* (1990). Ursula Kroeber Le Guin was born in Berkeley, California.

Legume is any of the plants that belong to the pea family. They make up the second largest family of flowering plants. The composite family is the largest (see **Composite family**). Botanists recognize between 14,000 and 17,000 *species* (kinds) of legumes. The group gets its name from the *legumes* (seed pods) that the plants bear.

Many legumes are of great economic importance throughout the world. Such legumes as peas, beans, and peanuts are valuable foods. Alfalfa, clover, and vetch are important forage and pasture plants. Other legumes yield medicines, dyes, oils, and timber.

Legumes grow in most parts of the world. They vary widely and may be trees, shrubs, or herbs. Many are climbing plants. The flowers of one large subfamily of legumes look like butterflies. Botanists call this group *Papilionoideae,* from the Latin word for *butterfly.* The common sweet pea belongs to this group. The flowers of other legumes may be small and regular. The flowers of still others may be irregular, with spreading petals.

Legumes take nitrogen into their roots from the air. Certain bacteria, called *rhizobia,* live in *nodules* (knotlike growths) that form along the roots of the plants. These bacteria take nitrogen from the air and change it into forms that can be used by plants. This characteristic makes leguminous plants valuable in agriculture. Farmers often use them as green manure and as cover crops to improve poor soil (see **Nitrogen**).

Each plant mentioned in this article has a separate article in *World Book.*

Scientific classification. Legumes make up the pea family, Leguminosae (Fabaceae).

Lehár, Franz (1870-1948), was the most important composer of operettas of the 1900's. His *The Merry Widow* (1905) is the most popular operetta in music history. Lehár's music is known for its interesting melodic development, colourful orchestrations, and skilful musical and dramatic use of counterpoint.

In ***The Merry Widow,*** Franz Lehár created a new kind of operetta, using waltz tunes and other dance rhythms.

Lehár's other important operettas include *The Count of Luxembourg* (1909) and *The Land of Smiles* (1929). Lehár also wrote an opera, *Giuditta* (1934). His instrumental compositions include 3 symphonic poems; about 65 dances, primarily waltzes; 2 violin concertos; and more than 50 marches. Lehár was born in Komárom, Hungary, but spent much of his career in Vienna.

See also **Operetta.**

Le Havre (pop. 197,219; met. area pop. 253,627) is the second busiest seaport city in France—after Marseille—and a major industrial centre. It lies along the English Channel, in northern France, at the mouth of the Seine River. For location, see **France** (political map).

Le Havre's port and centre were badly damaged during World War II (1939-1945). After the war, they were rebuilt according to a master plan. The port was equipped with excellent facilities that can accommodate very large vessels. Much of France's crude petroleum is imported at Le Havre. The city's many industries include shipbuilding, car assembling, and the production of chemicals, petrochemicals, and electrical goods.

Lehmann, Lotte (1888-1976), a German soprano, won fame as a concert and opera singer. She was known as an outstanding interpreter of the music of Richard Wagner and Richard Strauss. One of her finest creations was that of the Marschallin in Strauss's *Der Rosenkavalier.* She is also well remembered for her singing of the German art songs called *lieder.* She was born in Perleberg.

Lehmbruck, Wilhelm (1881-1919), was a German sculptor. His early work shows the strong influence of the French sculptor Aristide Maillol. Lehmbruck gave his early figures Maillol's solid forms and broad proportions. Lehmbruck added a mournful quality of expression to these early works.

About 1911, Lehmbruck's style changed. Largely under the influence of Gothic sculpture, he gave his figures exaggerated proportions that were elongated and slender. Lehmbruck's later works have increasingly slender forms and attitudes of despair reflecting the inner turmoil that led to his suicide. He was born in what is now Duisburg.

Leibniz, Gottfried Wilhelm (1646-1716), was a German philosopher, mathematician, and scholar. He and Sir Isaac Newton independently developed the theory of the differential and integral calculus (see **Calculus**). Leibniz also developed the binary numeration system and invented a calculating machine. He believed the truths of arithmetic could be derived from logical principles.

Leibniz developed a complex philosophical system. He believed that the ultimate elements of reality are indivisible, mindlike substances called *monads.* He identified the changing states of monads as "perceptions." But Leibniz thought only those monads that are true minds—divine, angelic, human, or animal—could perceive consciously. Leibniz said monads are "windowless"—that is, their states are generated from within the monad itself rather than being caused from without.

Although monads do not interact causally with each other, Leibniz believed that God created the world in such a way that the perceptions of any monad are "harmonized" with all others. In this and other ways, the world that God has chosen to create is the "best of all possible worlds." God can conceive of other worlds that would be better than this world in some ways. However, such other worlds would necessarily be worse in other ways. Material objects are not ultimate realities. They are only "appearances" arising from the perceptions of monads (see **Philosophy** [Rationalism]).

Leibniz was born in Leipzig. He travelled extensively in Europe on various diplomatic missions for German rulers. He spent much of his later life in Hanover, where he died.

Leicester (pop. 270,600) is a local government district and the administrative centre of Leicestershire, England. A leading industrial city, Leicester specializes in the manufacture of shoes and hosiery. Other industries include electrical engineering, food processing, printing, and production of adhesives and plastics.

Leicester lies on the site of *Ratae Coritanorum,* a Roman settlement on the ancient Fosse Way. Remains of a Norman castle lie on the bank of the Soar near St. Mary de Castro Church. St. Martin's Cathedral stands in the centre of the city.

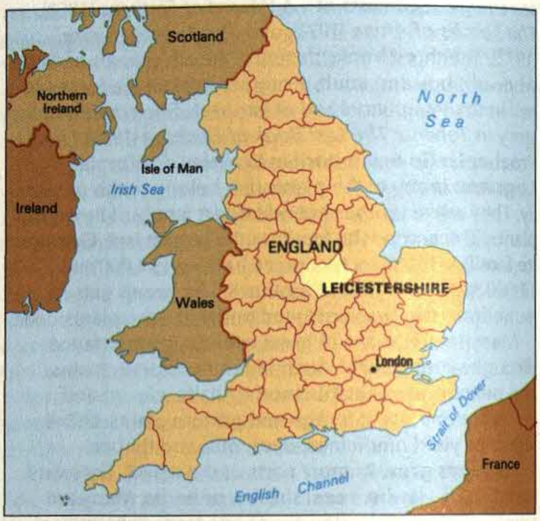
Leicester, Earl of (1532?-1588), an English nobleman, led a life of intrigue at the court of Queen Elizabeth I. He was the fifth son of the Duke of Northumberland.

The earl was a favourite of Queen Elizabeth. When his wife was found dead, Leicester was said to have killed her in order to marry the queen. But Elizabeth's advisers opposed the marriage. Leicester's marriage to the Countess of Essex in 1578 is believed to have angered Elizabeth. In 1580, she had Leicester arrested on a charge of plotting against her, but later released him. He led an English army against Spain in 1585. Leicester was born in Cornbury, Oxfordshire, England. His given and family name was Robert Dudley.

Leicestershire lies in the East Midlands of England. About 40 out of every 100 people in Leicestershire live in the city of Leicester. The county is highly industrialized in the area around Leicester. But in its country areas are some of the United Kingdom's best known foxhunts—the Belvoir, the Cottesmore, and the Quorn.

Leicestershire now includes what had been the tiny county of Rutland. Rutland had been the smallest county in England. The people of Rutland fought off an attempt to combine the two counties in 1963. But in the sweeping reorganization of England's local government in 1974, Rutland became a local government district within Leicestershire. As a result, its status as England's smallest county was taken over by the Isle of Wight.

Leicestershire is a highly industrialized county. But it has much fine scenery, such as the fields around Eyebrook Reservoir south of Uppingham.



The county of Leicestershire lies at the heart of England, in the region known as the East Midlands.

People and government

Local customs. Many people visit Hallaton on Easter Monday to see the traditional scrambling for hare pie and bottle kicking. Oakham Castle has an interesting collection of horseshoes. Peers of the realm who are passing through Oakham follow a custom of presenting a horseshoe to the castle. Queen Elizabeth I followed the custom, and members of the present Royal Family have also followed the custom.

Recreation. Leicestershire is well-known for foxhunting. Most of its famous hunts operate also in neighbouring counties, but the Cottesmore and Fernie hunts meet entirely in Leicestershire. Point-to-point horse racing is growing in popularity. Leicester has a racecourse that stages flat racing and steeplechasing. Leicester's soccer team plays in the Football League, and the county's cricket team plays in first-class cricket. Mallory Park, near Earl Shilton, and Donington Park, near Castle Donington, have regular motorcycle and motorcar racing. Angling enthusiasts find good sport in the county's canals, pools, and rivers.

Local government. Leicestershire is divided into nine local government districts: *Blaby,* which includes Narborough; *Charnwood,* which includes Loughborough; *Harborough,* which includes Market Harborough; *Hinckley and Bosworth; Leicester; Melton; North West Leicestershire,* which includes Coalville and Ashby de la Zouch; *Oadby and Wigston;* and *Rutland.* Leicestershire County Council, which has headquarters at Leicester, provides some public services throughout the county. The Crown Court meets at Leicester. The county's police force, the Leicestershire Constabulary, has headquarters at Leicester.

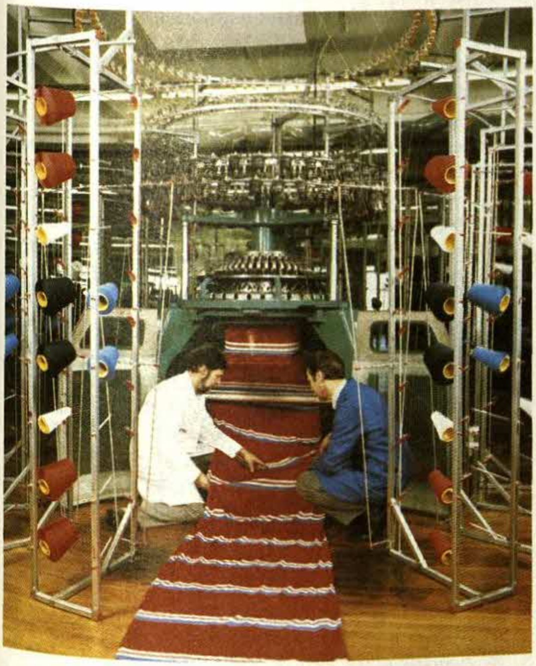
Facts in brief about Leicestershire

Area: 2,550 km².
Population: *1991 census*—860,500.
Administrative centre: Leicester.
Largest towns: Leicester, Hinckley, Loughborough, Wigston, Coalville.
Chief products: *Agriculture*—beef and dairy cattle, cheese, sheep. *Manufacturing and processing*—bricks, clothing, electronics goods, engineering goods, food products, footwear, hosiery, plastics, printing. *Mining*—coal, granite.

Economy

Manufacturing. Producing hosiery is one of Leicestershire's main industries. The county now produces, in addition to socks and stockings, knitted fabrics and knitted garments. Many associated industries have developed, such as dyeing and the manufacture of knitting machines. Leicester is the centre of this industry, and of many others, with products including adhesives, engineering products, and shoes. Hinckley has some industries similar to those of Leicester, particularly hosiery and engineering. Loughborough has engineering works and factories producing electrical goods and pharmaceuticals. One of the town's most famous industrial sites is its bell foundry, which was set up more than a hundred years ago. The biggest bell that rings in England was cast there. It is Great Paul, at St. Paul's Cathedral in the City of London.

Melton Mowbray is famous for pork pies, and also produces pet foods. Ashby de la Zouch makes soap and biscuits. At Market Harborough, the main products are chemicals and soups.



The clothing industry is important in Leicestershire. Multicoloured materials are produced on large knitting machines like the one shown above.

Agriculture. Much of the county's farmland is permanent grassland, on which beef cattle, dairy cattle, and sheep graze. The county's best-known dairy products are cheeses, particularly Stilton and Red Leicester. On the arable land, important crops are barley, oats, and wheat. Rose growing is also important.

Mining. Coal is mined at Asfordby, near Melton Mowbray. There are open-cast coal workings in the northwestern part of Leicestershire. Limestone is quarried near Ashby de la Zouch, and granite in the Charnwood Forest area. The northwestern part of the county produces a type of clay used for making bricks, pipes, and tiles.

Transportation and communication. Leicester and Loughborough are on the main railway line from London to Sheffield. Crosscountry lines run from Leicester through Hinckley to Birmingham, and from Leicester through Melton Mowbray and Oakham to Peterborough and Norwich.

The M1 and M42 pass through the county. The M69 links Leicester with Coventry and Birmingham. East Midlands Airport at Castle Donington has regular flights to other parts of the United Kingdom and to the continent of Europe. Leicester has a BBC local radio station and Leicester Sound, an independent radio station. Leicester has a daily newspaper. Several towns publish their own weekly newspapers.

Land

Location and size. Leicestershire is an almost heart-shaped county, bounded by the counties of Nottinghamshire and Derbyshire to the north, Lincolnshire to the east, Northamptonshire to the south, and Warwickshire and Staffordshire to the west. The distance between Bottesford, the most northern town in Leicestershire and the southern tip of the county is about 80 kilometres. The widest part of the county is about 86 kilometres from east to west.

Land regions. Leicestershire is divided into two parts by the River Soar as it flows northward to join the Trent. The two parts are not alike. To the west rise gently undulating, grassy hills, ranging between about

Places to visit

Following are brief descriptions of some of the interesting places to visit in Leicestershire:

Burrough Hill, near Melton Mowbray, is crowned by a well-preserved Iron Age fort, and has attractive scenery around it.

Charnwood Forest, near Coalville, has fine woodland and moorland scenery. It includes the ruins of Bradgate Park, formerly the home of Lady Jane Grey. The grounds are a nature reserve.

Leicester has the Jewry Wall, part of a public bath in Roman times. Leicester Castle's hall dates from the 1100's. The church of St. Mary de Castro was started in 1107. The city has many other fine buildings and several museums.

Rutland Water is the second largest artificially made lake in the United Kingdom. Its attractions include fishing, sailing, birdwatching, boat and cycle hire, and a trail through a nature reserve.

Snibston Discovery Park, Coalville, includes a science discovery centre, an outdoor science play area, and a country park.

Staunton Harold, near Ashby de la Zouch, has a church that is the only one built in England during the Protectorate (see Protectorate).

90 and 120 metres above sea level. In the northwest, the hills are composed of the ancient mass in an area called *Charnwood Forest.* These hills reach 278 metres at Bardon Hill, the highest point in the county. The Charnwood rocks are among the oldest in England and are of great interest to geologists.

High, grassy uplands rise to the east of the Soar. These vary from 120 to 180 metres. But, in some places, they reach heights of over 210 metres in flat-topped summits, such as Whatborough and Robin-a-Tiptoe.

Rivers. The two main rivers draining the county are the River Soar and the River Wreake, which joins the Soar just below Leicester. The River Welland forms much of Leicestershire's southern boundary, and the River Trent forms part of the northern boundary.

Climate. Leicestershire's average yearly rainfall is about 660 millimetres. September is the wettest month. The average temperature for January is 4° C, and the average temperature for July is 16° C. Winters tend to be dry and severe. In the spring, cold easterly winds often blow as late as May. Summers are warmer than the average for many parts of England, but tend to be sultry, with frequent thunderstorms.

History

Leicester probably already existed as a settled community in about 50 B.C. It was certainly the tribal capital of the *Coritani,* a late Iron Age tribe. Following their invasion of Britain in A.D. 43, the Romans named the city *Ratae Coritanorum* after the tribe. Leicester has substantial remains dating from the Roman period.

Leicestershire (the *shire,* or administrative division, of Leicester) was probably first created in the late 800's, after the Danish occupation of Mercia in 876. John of Gaunt, fourth son of Edward III, was created Duke of Lancaster in 1362, and made Leicester Castle one of his favourite residences. He died there in 1399.

A decisive battle was fought in Leicestershire, at Bosworth Field, in 1485, when the future Henry VII defeated Richard III. Richard was killed in the battle. He was buried in the church of the Grey Friars. Historians claim that Richard's body was dug up and thrown into the River Soar after the dissolution of the Grey Friars' monastery in the 1500's.

The historian Lord Macaulay was born at Rothley Temple. George Fox, founder of the Society of Friends (Quakers), was born at Fenny Drayton, near Hinckley. The conspirator Titus Oates was born at Oakham.

Related articles in ***World Book*** include:

Fox, George
Macaulay, Thomas Babington
Quakers
Bosworth Field
Leicester
Oates, Titus

Leichhardt, Ludwig (1813-1848), was a German-born explorer. His disappearance while on a journey across Australia still remains a mystery. He tried to find a practical route from Moreton Bay (now Brisbane) to Perth. He left Moreton Bay in February 1848, with a party of seven men, including two Aborigines. Historians believe that the expedition was ill-equipped, because Leichhardt assumed that his party could live off the countryside. The party completely disappeared. During the next 90 years, nine major searches were organized to try to find traces of the party. Many minor searches were also organized. Some of them found bones and other relics. But none of them found definite evidence to link their discoveries with Leichhardt.

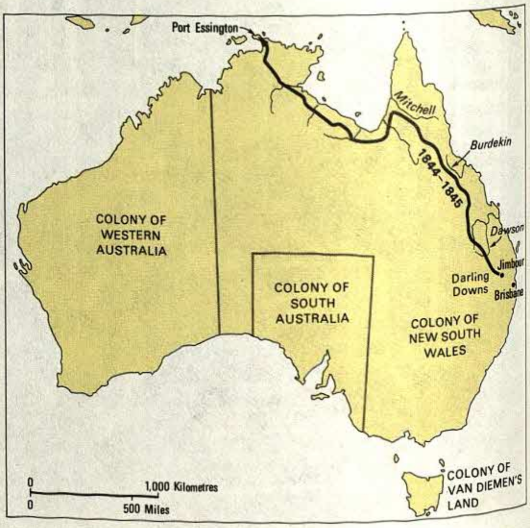
Ludwig Leichhardt

Many theories have been advanced to explain what happened to the party. According to one story, the party mutinied and killed Leichhardt and all were later killed by Aborigines except for one member, Adolf Classen, who lived on among the Aborigines. Some historians believe that Leichhardt and his party could have died in sudden floods in the Channel Country in Queensland. Other historians are of the opinion that Leichhardt and his party probably died of thirst.

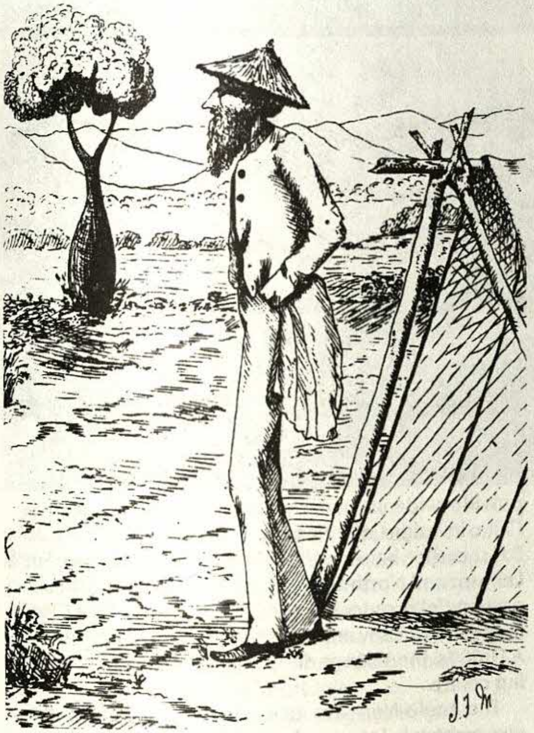
In 1852, the first expedition set out to look for the party. It was led by Hovenden Hely, who had been a member of an earlier Leichhardt expedition. He searched wide areas of western Queensland but found no trace of the missing party. In 1871, the Queensland government sent J. M. Gilmour, a subinspector of police, on two expeditions to investigate reports that a European was living with Aborigines. Gilmour found several skeletons, pieces of clothing, and a tomahawk. However, he found no trace of a European living with Aborigines.

The last search party set out in 1938 under Sir Grenfell Price. They went into the Simpson Desert to look for remains and found some bones and a coin dated 1841, the year Leichhardt left England. But nothing they found could be conclusively linked with Leichhardt.

Leichhardt was born at Trebatsch in Prussia (now in Germany). His full name was Friedrich Wilhelm Ludwig Leichhardt. He studied at the universities of Berlin and


Port Essington
Mitchell
Burdekin
1844–1845
COLONY OF WESTERN AUSTRALIA
COLONY OF SOUTH AUSTRALIA
COLONY OF NEW SOUTH WALES
Dawson
Jimbour
Darling Downs
Brisbane
COLONY OF VAN DIEMEN'S LAND
0
1,000 Kilometres
0
500 Miles

Ludwig Leichhardt explored the area between Darling Downs and Port Essington in 1844 and 1845. He discovered and named many rivers, including the Dawson, Burdekin, and Mitchell.



Ludwig Leichhardt was sketched by the artist J. F. Mann. The sketch shows the explorer near a bottle tree.

Göttingen. Leichhardt went to Australia to study its wildlife. He landed in Sydney in 1842.

In 1843, he journeyed overland from Newcastle to Moreton Bay. On October 1, 1844, he left the Darling Downs with a party of nine men on an overland expedition to Port Essington, near Darwin. The expedition was privately financed by Brisbane squatters and businesspeople who were anxious to find a new trade route to Port Essington. The expedition took with it provisions that were inadequate for the journey.

The path the expedition pursued was an uncertain one. It ran roughly parallel with the Queensland coast to the Burdekin River, northwest to the Mitchell River, southwest around the Gulf of Carpentaria to the Roper River, then northwest to Port Essington. Leichhardt was such a poor bushman that the expedition continually lost its way. Two of the party turned back shortly after the expedition commenced. John Gilbert, another member, was killed when Aborigines attacked Leichhardt's camp. Food was often in short supply. Seven men finally reached Port Essington on December 17, 1845. They had travelled across more than 4,800 kilometres of country.

In 1846, Leichhardt attempted to cross the continent, from the Darling Downs in Queensland to the Swan River in Western Australia. He was forced to turn back.

Leiden, also spelled *Leyden* (pop. 103,819; met. area pop. 174,501), lies 35 kilometres southwest of Amsterdam on the Rhine River (see **Netherlands** [map]). It lies 116 centimetres below sea level. The city is a centre of printing and light industry. Leiden is noted for its many museums. William of Orange founded the Netherland's first university in Leiden in 1575 to reward the citizens for their heroic defence against a siege by the Spaniards in 1574. During the early 1600's, Leiden was the home of about 40 of the Pilgrims who sailed to America on the *Mayflower* in 1620.

Leigh-Mallory, Sir Trafford (1892-1944), was one of the leaders of the Royal Air Force Fighter Command during the Battle of Britain, in 1940 (see **Battle of Britain**). He led No. 12 Fighter Group from 1937 to 1940. Later, he commanded No. 11 Fighter Group. In 1942, he was appointed chief of Fighter Command. The next year, he was made commander-in-chief of the Allied Expeditionary Air Force, which supplied the protective "air umbrella" that helped to make the Allied invasion of Europe in June 1944, successful. Leigh-Mallory died in an air accident. He was born at Mobberley, in Cheshire, England.

Leighton, Lord (1830-1896), Frederic Leighton, was an English painter and sculptor in the classical style that was inspired by the art of ancient Greece. Among his most famous paintings is *Cimabue's Madonna Carried Through the Streets of Florence.* His bronze sculpture *Athlete Struggling with a Python* is in the Tate Gallery, London. Leighton was born at Scarborough. He was educated in Italy and studied art in various art centres in Europe. He became president of the Royal Academy in London in 1878 and was knighted the same year. He was made a baron the day before he died.

Leinster is one of the four provinces of Ireland. It occupies much of the eastern and central part of the Republic of Ireland. Leinster consists of 12 counties: Carlow, Dublin, Kildare, Kilkenny, Laois, Longford, Louth, Meath, Offaly, Westmeath, Wexford, and Wicklow. The province also contains the city of Dublin, the capital of the Republic of Ireland. It is the most economically developed of the provinces.

People and government. The population of Leinster has increased much more than other parts of the country since independence in the 1920's. Growth has been greatest in and around the city of Dublin.

About 90 per cent of the people of Leinster are Roman Catholic. The next largest religious group is the Church of Ireland, and there are much smaller numbers of Presbyterians and Methodists. In Dublin city there is a significant Jewish community.

County Dublin elects 48 members to *Dáil Éireann* (the lower house of the Republic of Ireland's parliament). The other counties make up eight constituencies, and are represented by 37 members of parliament.

Facts in brief about Leinster

Population: *1991 census*—1,860,037.

Area: 19,633 km².

Counties: Carlow, Dublin, Kildare, Kilkenny, Laois, Longford, Louth, Meath, Offaly, Westmeath, Wexford, Wicklow.

County borough: Dublin.

Largest towns: Dublin, Dun Laoghaire, Dundalk, Bray, Drogheda, Kilkenny, Athlone, Wexford, Swords, Carlow, Lucan, Mullingar, Leixlip, Navan, Newbridge, Naas.

Chief products: *Agriculture*—barley, cattle, horses, milk, sheep, sugar beet, wheat. *Other primary products*—fish, peat, sand and gravel, stone, timber. *Manufacturing*—beer, chemicals, clothing, electronic and electrical goods, food products, machinery, paper and printed materials, textiles.

Origin of name: From the Irish name for the area *Laighean,* and the Danish *stadr* (a place).

Huge country areas with scattered villages lie inland, away from the industrial centres of Leinster. This village is Inistoige, on the Nore river in County Kilkenny.

Economy. Most land of Leinster is agricultural. Chief arable crops are barley, oats, potatoes, sugar beet, turnips, and wheat. Market gardens in Dublin supply the city with vegetables and fruit. Farmers raise beef and dairy cattle, horses, and sheep are also important.

Over a fifth of the population work in the manufacturing industry. Dublin is by far the largest industrial centre, followed by Dundalk, and Drogheda. More than half of the people work in service industries.

Peat from the Midland bogs is of great importance. Stone, sand, and gravel quarries supply the construction industry in Dublin. One of the world's largest lead and zinc mines is at Navan in County Meath.

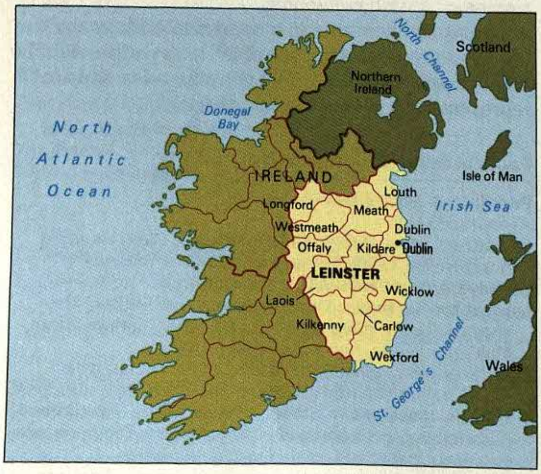
Land. Much of Leinster is in the central lowland of Ireland. The main upland area is in the southeast, where the Leinster Chain extends from Dublin through the Wicklow Mountains to the Blackstairs Mountains.

Leinster is the driest and sunniest of Ireland's provinces. The yearly rainfall rises from 75 centimetres on the lowlands to more than 150 centimetres on the Wicklow Mountains. The average temperature is 5° C in January and 16° C in July.

History. The tombs of Newgrange and other burial sites in the Boyne valley, dating from about 3000 B.C., provide evidence of early human settlement. After the Celtic invasions of Ireland, which took place in the 300's B.C., Leinster became divided into two kingdoms, South Leinster and North Leinster (or Meath). See **Meath.** Important Celtic monastic sites in Leinster include Glendalough in Wicklow and Clonmacnoise in Offaly. From the A.D. 800's, the Vikings developed Dublin as a major trading centre.

The Anglo-Normans arrived in 1169. English control was greater in Leinster than in other provinces. In the 1500's, British settlers colonized part of the Midlands. King William III defeated King James II at the Battle of the Boyne in 1690. Because of its eastern position, and Dublin's role as the centre of power, many important events in Irish history have occurred in Leinster. Among the most famous was the Easter Rising of 1916.

See also the article on each county mentioned in this article.



Leinster is a province of great scenic beauty. Much of the province lies in the central lowland region of Ireland.

Leinster House. See **Dublin** (People and government); **Oireachtas.**

Leipoldt, Christian (1880-1947), a South African doctor, journalist, and playwright, became one of the most celebrated poets and authors in Afrikaans literature. Christian Frederick Louis Leipoldt was born in the Cape Province, where his father was a missionary. He worked as a journalist before going to London to study medicine. In 1911, Leipoldt produced his first volume of poetry, *Oom Gert Vertel en Ander Gedigte* (Uncle Gert Relates and Other Poems). This book, inspired by the suffering inflicted by the second Anglo-Boer War (1899-1902), earned him great acclaim. His book, *Bushveld doctor* (1937) described the harsh life of rural schoolchildren in South Africa. He became familiar with this subject while he was a school medical inspector in the Transvaal in 1914. Leipoldt was also known for his interest in local cooking. His book *Kos vir die Kenner* (1933) was published in English after his death as *Leipoldt's Cape Cookery.*

Leipzig (pop. 554,595), a city in Germany, is a trade, industrial, and cultural centre. Leipzig is also the name of the surrounding administrative district. The city developed into a prosperous trading centre during the Middle Ages because it lay at the intersection of several European trade routes. Leipzig later became world famous

Leipzig's Old City Hall is one of many landmarks in this historic German city. The building served as the city hall from 1556 to 1907. Restored after World War II, it now houses the Museum of the History of the City of Leipzig.

for its great trade fairs, and gained a reputation as one of the greatest literary and musical centres of Europe. About a fourth of the city's buildings were destroyed during World War II (1939-1945). After the war, Leipzig became a part of Soviet-controlled East Germany. In 1952, the district of Leipzig was created from parts of Saxony, Saxony-Anhalt, and Thuringia.

Location and description. Leipzig lies in east-central Germany, in the northwest corner of the former German state of Saxony. It is about 105 kilometres northwest of Dresden (see **Germany** [political map]). The inner part of Leipzig includes the Old City Hall, several churches, and some other buildings that are hundreds of years old. Many historic buildings were damaged during World War II but were carefully restored afterward. Leipzig's famous trade fairs are held in the centre of the city and just outside the city. Leipzig's suburbs include Mockau, Gohlis, Eutritzsch, Möckern, Lindenau, Plagwitz, Connewitz, Stötteritz, Reudnitz, Volkmarsdorf, Schönefeld, and Wahren.

Industry. Leipzig became a centre of fur-trading early in its history. Later, it grew into a great manufacturing city. Its industries include wood carving, papermaking, and the manufacture of many kinds of scientific instruments. The city is a centre of textile manufacturing, and also makes steel products, plastics, and processed food products. Before World War II, Leipzig was the centre of German book and music publishing. At one time more than 270 newspapers and magazines were published in the city. Only about 35 of the 400 publishing houses that thrived there before the war are still in operation.

Transportation. Leipzig's location at the junction of the Elster, Pleisse, Parthe, and Weisse rivers makes it a great port. A canal connects the city with the Elbe and Saale rivers. Leipzig has two large airports, and is an important railway and road centre.

Cultural life. There are many schools, art galleries, and museums in Leipzig. The University of Leipzig (renamed Karl Marx University by the Communists after World War II) was founded in 1409. One of its most famous graduates was the great German poet Johann Wolfgang von Goethe. Other Leipzig schools include a conservatory founded by the composer Felix Mendelssohn in 1843, an art college, and an academy of graphic and book arts. Leipzig has played a great part in the history of German music. Johann Sebastian Bach, Robert Schumann, Mendelssohn, and other musical figures lived in the city. The composer Richard Wagner and the philosopher Gottfried Leibniz were born there. The city enjoyed its greatest period as a centre of music and literature during the 1800's.

History. Leipzig was chartered in 1174, and became a trade centre. Its printing industry dates from around 1480. The city became a battleground during the religious wars of the 1600's. The first Battle of Leipzig was fought near the city in 1631. Swedish forces led by Gustavus Adolphus won a great victory over the German army. The second Battle of Leipzig, fought between the Germans and the Swedes in 1642, also was won by the Swedes. They occupied Leipzig until 1650. In 1813, in the third Battle of Leipzig, Prussia, Russia, Austria, and Sweden defeated Napoleon.

The first major German railway began operating between Leipzig and Dresden in 1839.

Leisler, Jacob (1640-1691), served as governor of the English colony of New York from 1689 to 1691. The people of the middle class chose him as their protector against attacks from the French in Canada. They regarded him as their champion against the wealthy merchants and landowners. He ruled without authority from the king, and, when William and Mary became rulers of England, they sent Henry Sloughter to replace him. Leisler yielded to Sloughter, but the merchants and landowners accused him of treason. Leisler was tried and executed. He was born in Frankfurt, Germany.

Leisure. See **Recreation.**

Leith, Treaty of. See **History of Scotland** (The Reformation).

Leitrim is one of the five counties that make up the province of Connacht in the northwest of the Republic of Ireland. It is a rural county, but the land is of poor quality. Leitrim is famous for the beauty of its mountains and valleys in the north, and its hills and lakes in the south. The largest town is Carrick-on-Shannon.

People and government. The population of Leitrim is less than one-fourth of what it was in 1850 and less

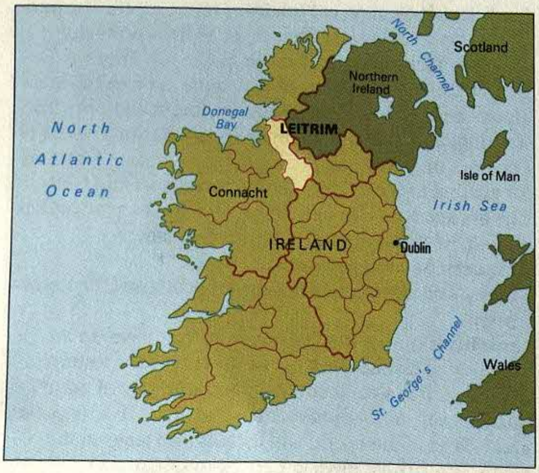
A small waterfall tumbles from an escarpment on the slopes of Glencar Mountain in north Leitrim.

than half what it was at national independence in the 1920's. Only one-tenth of the population lives in towns.

About 95 per cent of the people of Leitrim are Roman Catholic. Most of those of other denominations are members of the Church of Ireland.

Four members of parliament represent Leitrim and Sligo in *Dáil Éireann* (the lower house of parliament).

Economy. Most of the land is wet and infertile. It is not suitable for arable crops, and less than 1 per cent of the agricultural land is cultivated. The grassland is used mainly for rearing young beef cattle, which are sold for fattening elsewhere. There is also some dairy and sheep farming. Despite the difficulties, nearly one-third of Leitrim's people work in agriculture.



Leitrim is part of the province of Connacht in northwest Ireland. It is less than 30 kilometres at its widest.

Facts in brief about Leitrim

Population: *1991 census*—25,297.
Area: 1,525 km².
Largest towns: Carrick-on-Shannon, Manorhamilton, Mohill, Ballinamore.
Chief products: *Agriculture*—cattle, milk, pigs, sheep, timber. *Manufacturing*—clothing, electrical and other metal goods, food products, timber products.
Origin of name: From the Irish *Liath-druim* (grey ridge).

One-sixth of Leitrim people work in the manufacturing industry. The main centres are Carrick-on-Shannon, Ballinamore, and Mohill. Most of the industries are modern and of small size. Varied service industries account for two-fifths of employment.

The railway and the N4 road from Dublin to Sligo pass along the southwestern edge of Leitrim. In the north are the N15 and N16 roads from Sligo toward Donegal and Enniskillen respectively.

Land. Leitrim is a border county. A part of its northern boundary is with Fermanagh in Northern Ireland. County Donegal lies to the north, County Cavan to the northeast, County Longford to the southeast, County Roscommon to the southwest, and County Sligo to the west. Leitrim is long and narrow, measuring 80 kilometres from northwest to southeast. It is less than 30 kilometres at its widest.

Southern Leitrim forms part of the northwestern edge of the central lowland of Ireland. It consists mainly of limestone, covered with low hills of soil and other material left behind by glaciers. These little hills are called *drumlins.* In the hollows between the hills there are many lakes and marshy areas.

In northern Leitrim, there is a high plateau cut by deep valleys. Lough Allen occupies much of a broad valley in the centre of the county. The River Shannon flowing from it forms part of the western boundary.

The annual rainfall is 100 centimetres on the lowlands and over 150 centimetres on the uplands. The average temperature in January is 5° C. In July it is 15° C.

History. Leitrim was originally the kingdom of West Breifne, which was ruled over by the O'Rourke clan. Despite the Anglo-Norman invasion of Ireland, which took place in the 1100's, the O'Rourkes remained in control until the 1600's. At that time a few British settlers arrived in Leitrim. Carrick-on-Shannon, Jamestown, and Manorhamilton were established as towns at that time. Parke's Castle is a fine fortified dwelling on the shore of Lough Gill and near Dromahair, which had been a seat of the O'Rourkes. Leitrim suffered badly during the Great Famine of the 1840's, when more than one-fourth of the population died or emigrated.

See also **Ireland, History of.**

Leland, Henry M. See **Car** (The United States car industry).

Lely, Sir Peter (1618-1680), was a Dutch-born painter known for his portraits of English royalty and famous naval personalities. Lely painted portraits for Charles I, Oliver Cromwell, and Charles II. Charles II appointed him court painter and, in 1679, knighted him. Today, sev-

A portrait of the Countess of Shrewsbury, *above,* is one of Sir Peter Lely's many paintings of English royalty and of well-known people of his day.

eral of Lely's portraits hang in Hampton Court Palace and in the Great Hall at Greenwich.

Lely was born in the city of Utrecht, in the Netherlands. His real name was Pieter van der Faes. He studied art in the Netherlands and settled in England in 1641. He was knighted in 1679.

Le Mans (pop. 147,697; met. area pop. 200,000) is a city in western France. It lies along the Sarthe River (see France [political map]).

Le Mans is famous as the site of an annual 24-hour sports car race. The Cathedral of St. Julien stands in the old central section of Le Mans. Built between the 1000's and 1200's, it is noted for its Gothic architecture and large stained-glass windows. The outskirts of the city have much industry and modern housing.

Le Mans serves as the capital of the Sarthe *department* (administrative district). It is an important grain market and the commercial and railway centre of its region. The city's factories produce agricultural machinery, cars, electrical equipment, paper, plastics, textiles, and tobacco products.

Le Mans dates from ancient times. Julius Caesar conquered the area about 50 B.C. A major battle of the French Revolution took place in Le Mans in 1793. In 1871, Prussian armies defeated the French at Le Mans during the Franco-Prussian War.

Lemass, Seán (1899-1971), became Prime Minister of the Republic of Ireland and leader of the Fianna Fáil Party in 1959. He worked to strengthen the economy by encouraging new industries. He retired in 1966 and was succeeded by John Lynch. Lemass was born in Dublin and was educated at Irish Christian Brothers' schools. He took part in the Easter Rebellion of 1916. During the struggle for Irish independence, he was imprisoned several times.

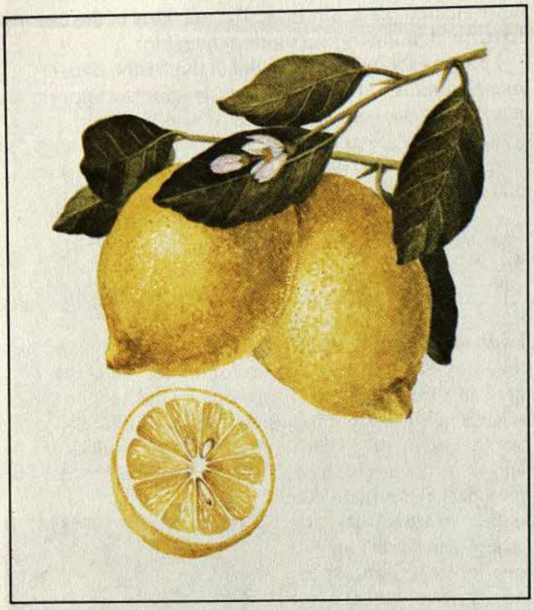
Lemass was elected to Dáil Éireann, the Irish parliament, in 1924. In 1932, he became Minister for Industry and Commerce. He held this post, except for short periods, until he became Prime Minister. He was *Tánaiste* (deputy prime minister) for three periods.

Seán Lemass

LeMay, Curtis Emerson (1906-1990), commanded the Strategic Air Command of the United States Air Force from 1948 to 1957. During a period in which American foreign policy depended heavily upon the striking power of the Strategic Air Command's long-range bombers, LeMay became one of America's most famous airmen.

In 1957, LeMay became Vice Chief of Staff of the Air Force. He served as Air Force Chief of Staff from 1961 until January 1965, when he retired as a four-star gen-

Le Mans racing circiut, just south of the city, is the site of the annual 24-hour Grand Prix endurance race for sports cars. The winner is the car that travels farthest within the time period.



Lemon, *left,* is a popular citrus fruit that is grown mainly for its tart juice and fragrant oil. Lemons are rarely eaten as fresh fruit. Lemon trees, *above,* bear fruit throughout the year, and so growers harvest the fruit up to 10 times annually.

eral. In 1968, LeMay was the American Independent Party candidate for vice president of the United States. George C. Wallace was the presidential candidate.

LeMay was born in Columbus, Ohio, and graduated from Ohio State University. He enlisted as a flying cadet in the Army Air Corps in 1928. During World War II, he won attention as a bomber commander in Europe. In 1943, he commanded the Third Bombardment Division of the Eighth Air Force. In September 1944, LeMay took command of the 20th Bomber Command in India.

When the Pacific islands of Guam and Saipan became the main bases for the growing B-29 offensive against Japan, LeMay became commander of the 21st Bomber Command. From January 1945 until the end of the war, he directed an air assault against Japan.

Lemming is a plump little animal related to the mouse. Lemmings live in the cold, northern parts of the world. The best-known kind lives in Scandinavia. Sometimes there are great increases in lemming populations, and the animals move away from their mountain homes because of crowding. Most of them die of starvation or are killed by other animals. Lemmings play an important part in the Arctic food chain. They are preyed upon by birds such as skuas and owls, and by stoats and foxes.

Lemmings are from 10 to 13 centimetres long, including their stubby tails. Most kinds are grey or brown. Lemmings eat plants. They dig soil to build their nests, which they line with grass and moss.

Scientific classification. Lemmings are in the family, Cricetidae. Lemmings make up the genus *Lemmus.*

See also **Animal** (picture: Animals of the polar regions).

Lemon is a small, oval citrus fruit. People in many parts of the world enjoy lemon-flavoured foods and beverages. Lemons have a pleasing scent, and most varieties have a tart taste. Lemons are rich in vitamin C and contain several B vitamins.

The lemon is a type of berry called a *hesperidium.* A lemon measures about 7.5 centimetres in length and about 5 centimetres in diameter. It has a nipplelike bulge at one end. The interior of the fruit consists of 8 to 10 segments, which contain the pulp, juice, and seeds. The leathery yellow rind has many tiny glands, which produce a spicy oil.

People rarely eat fresh lemons because of the fruit's sour taste. However, lemon juice and oil are used in a wide variety of food products. For example, lemonade, several soft drinks, and many other beverages are made with lemon juice. Such foods as sweets, cakes, biscuits, and salads, as well as various fish and meat dishes, are flavoured with lemon juice and oil.

Lemon oil is also used as a scent in various nonfood items, such as household cleaning products, soap, and shampoo, perfume, and other cosmetics.

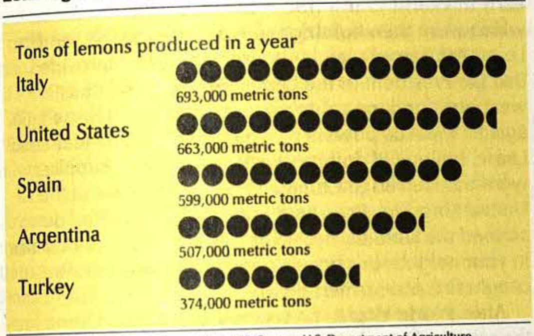
More than 3.2 million metric tons of lemons are grown throughout the world annually. The world's three leading lemon-producing countries are Spain, the United States, and Italy.

Growing lemons. Lemon trees can grow from 6.5 to 7.5 metres tall. They are covered with thorns and have long, pointed, pale green leaves. The trees produce large, white, fragrant flowers throughout the year, except for the winter. Lemons develop from the ovaries of the blossoms and ripen about 7 or 8 months after the flowers bloom. Lemon trees may carry blossoms and fruit at the same time.

Lemon trees are grown from buds cut from trees that produce the type of lemon desired. The buds are grafted to seedling lemon trees called *rootstocks* (see **Grafting** [Other kinds of grafting]). Rootstock varieties are chosen for their resistance to disease and for various other reasons. Lemon trees start to produce fruit about 4 years after grafting, and some continue to bear fruit for 50 years.

Lemon trees may be severely damaged by frost and freezing temperatures. They may also be attacked by such insect pests as mites, scale insects, and thrips. Growers combat the insects by growing varieties of

Leading lemon-growing countries



Figures are for a three-year average, 1990-1992. Source: U.S. Department of Agriculture.

trees that resist pests and by spraying the trees with insecticides. They also spray orchards with fungicides to fight fungal diseases, which attack the leaves, fruit, and roots of the trees.

Harvesting and processing. Lemon trees bear fruit throughout the year, and growers harvest the fruit 2 to 10 times a year. Lemons that are to be sold as fresh fruit are picked before they grow to full maturity. Then they are cured and stored under special conditions.

History. Lemons probably originated in northeastern India. Lemons were taken from India to Italy by the Arabs in the A.D. 100's, and to Spain in the A.D. 1100's.

Scientific classification. Lemons are members of the rue family, Rutaceae. Commercial lemons belong to the species *Citrus limon.*

See also **Citric acid; Citrus; Fruit.**

Lemon balm is a perennial plant of the mint family. It comes from the Mediterranean region. The leaves are broad, toothed and smell strongly of lemon when crushed. The flowers are small, white or pale yellow, arranged in *whorls* (spirals) around the stem. The leaves are used as a flavouring in salads, soups, and egg dishes. An oil distilled from the plant is used to make perfumes.

Scientific classification. Lemon balm belongs to the mint family *Labiatae* (Lamiaceae). It is *Melissa officinalis.*

Le Moyne, Charles (1626-1685), a Canadian colonist, founded the city of Longueuil. He was the first of a large family of French-Canadian heroes. Le Moyne left France in 1641. In Canada, he lived first at a Jesuit mission to the Huron Indians, where he learned several Indian dialects. Later, he became a fur trader, farmer, and soldier.

The French government honoured Le Moyne with many titles, including that of *Sieur de Longueuil,* and gave him large grants of land. Le Moyne encouraged many French settlers to live on these lands and helped them during their pioneer years. He was born in Dieppe, France.

Seven of Le Moyne's sons won fame fighting for France. Two of his sons, Sieur d'Iberville and Sieur de Bienville, explored the gulf regions of the Mississippi River and the river mouth. They claimed the land for France. Sieur d'Iberville served as governor general of the region and, upon his death, Sieur de Bienville succeeded him. Sieur de Bienville founded the city of New Orleans in 1718.

Charles Le Moyne

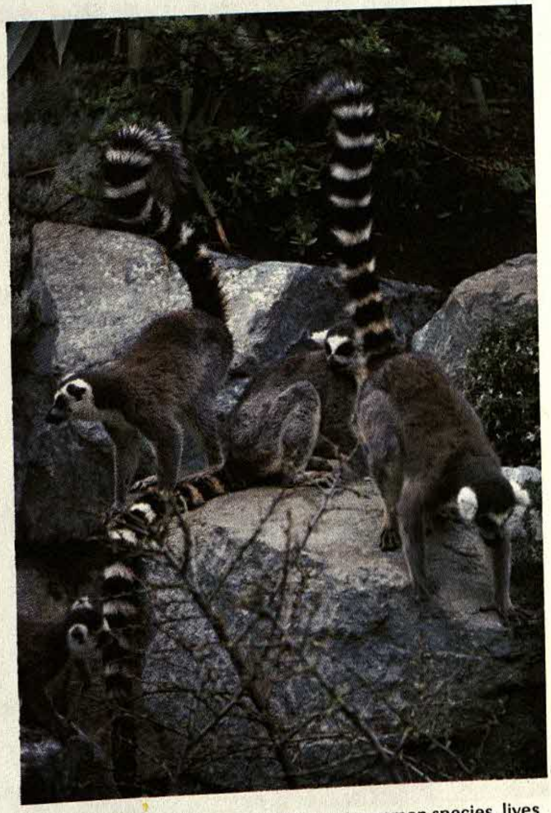
See also **Iberville, Sieur d'.**

Le Moyne, Pierre. See **Iberville, Sieur d'.**

Lemur is a long-tailed mammal with fluffy fur. Some kinds of lemurs resemble monkeys. Others look more like mice or squirrels. Scientists classify lemurs, along with human beings, apes, and monkeys, as *primates.* Lemurs live only in Madagascar and Comoros, which are island countries off the southeast coast of the African mainland.

Most lemurs live in trees most of the time. They eat fruit, leaves, birds and their eggs, and insects and other small animals. Some kinds of lemurs move about chiefly during the day. Other lemurs are *nocturnal*—they are active at night.

Lemurs vary greatly in size, colour, and appearance. The *lesser mouse lemur,* one of the world's smallest primates, weighs 57 grams and grows 13 centimetres long, not including the tail. These brownish or greyish animals look like furry mice. *Ringtailed lemurs* and *ruffed lemurs* resemble monkeys, except that they have a long pointed snout. The ring-tailed lemur grows up to 38 centimetres long. This animal has a grey back, white underparts, and rings of black-and-white fur on its tail. The



The ring-tailed lemur, one of the most common species, lives in the southwest part of Madagascar. Unlike other lemurs, it usually dwells on the ground rather than in trees.

ruffed lemur grows 60 centimetres long and has especially fluffy fur. Most ruffed lemurs have a black-and-white coat with a fluffy white *ruff* (collar). Some have reddish-brown fur instead of white. Another kind of lemur, the *aye-aye,* does not resemble any of the other lemurs (see **Aye-aye**).

Two monkeylike lemurs, the *indri* and the *sifaka,* have long, powerful hind legs. In the trees, these lemurs spring from trunk to trunk. Most animals that live in trees jump from branch to branch. The indri, the largest kind of lemur, grows about 70 centimetres long. It has a black back and white fur on its undersides. The sifaka grows about 50 centimetres long.

Lemurs have few enemies. There are few large *predators* (animals that eat other animals) where they live. But many species have become endangered. People have cut down forests in which these animals lived.

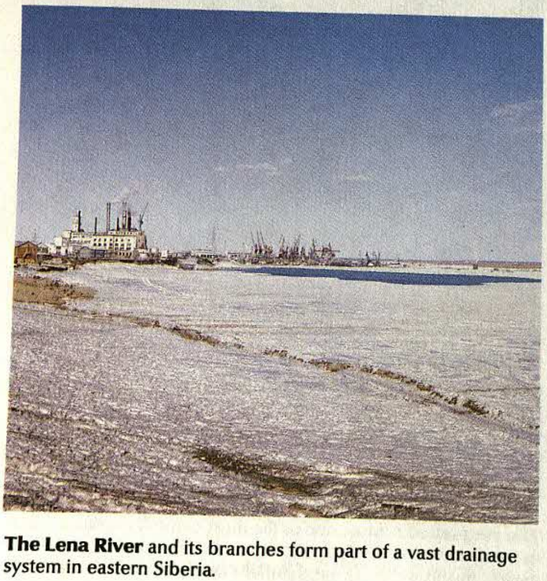
Scientific classification. The lesser mouse lemur, belongs to the family Cheirogaleidae. It is *Microcebus murinus.* The ring-tailed lemur and the ruffed lemur belong to the family Lemuridae. The ring-tailed lemur is *Lemur catta.* The ruffed lemur is *Varecia variegata.* The indri and the sifaka belong to the family Indriidae. The indri is *Indri indri.* Sifakas form the genus *Propithecus.* A common species is *P. verreauxi.*

Lemur, Flying. See **Flying lemur.**

Lena River is the chief waterway of a large district of eastern Siberia. The river rises on the slopes of the Baikal Mountains and flows northeast for 4,400 kilometres. It empties into the Arctic Ocean through the Laptev Sea. The river's delta is about 402 kilometres wide. Ships can sail up the river for about 3,200 kilometres.

The Lena River drains an area of about 2.6 million square kilometres, which is nearly one-third the size of Canada. For the location of the river, see **Russia** (terrain map). Its chief branches are the Vitim, Olekma, Aldan, and Vilyuy rivers.

Along its middle course, the Lena River flows through a region that is inhabited by the Yakuts, a Turkic people. The Yakuts make their living by fishing, farming, and rearing livestock. The largest city on the river is Yakutsk.



The Lena River and its branches form part of a vast drainage system in eastern Siberia.

Lend-Lease was a plan developed by the United States early in World War II (1939-1945) to aid the countries which were then fighting the Axis powers. The Lend-Lease Act became law on March 11, 1941. It provided that the President of the United States could transfer weapons, food, or equipment to any nation whose fight against the Axis powers aided U.S. defence. Under Lend-Lease, billions of dollars worth of American supplies were transferred to China, the Soviet Union, and the United Kingdom. President Franklin D. Roosevelt described the Lend-Lease Act as helping to put out the fire in your neighbour's house *before* your own house caught fire and burned down.

After World War II, no terms were decided upon for the return of goods by countries that received equipment from the United States under the Lend-Lease Act. Some countries, especially the United Kingdom, had already balanced part of the account by furnishing goods and services to U.S. troops.

Lendl, Ivan (1960-), is one of the world's top tennis players. He was ranked number one in the world for 156 consecutive weeks during 1985, 1986, and 1987. Lendl won the United States Open in 1985, 1986, and 1987. He also won the French Open in 1984, 1986, and 1987, and the Australian Open in 1989. His powerful, disciplined game makes him one of the most consistent players in the sport.

Lendl was born in Ostrava, in what is now the Czech Republic. Both his parents were highly ranked tennis players. After winning several junior titles, Lendl turned professional in 1979. He settled in the United States in the mid-1980's and became a U.S. citizen in 1992.

See also **Tennis** (picture: Modern men tennis stars).

L'Enfant, Pierre Charles (1754-1825), a French engineer and architect, became the first modern city planner in the United States. In 1791, he was commissioned to prepare a plan for the new U.S. capital city in the District of Columbia. His plan envisioned a city of parks, public buildings, and wide, radiating streets. After a disagreement with President George Washington, L'Enfant was dismissed as engineer-in-charge in 1792. But his plan formed the basis for the development of Washington, D.C. See **Washington, D.C.**

L'Enfant was born and educated in Paris. He went to America in 1777, and served as an engineering officer in the American Revolution. He designed Federal Hall in New York City.

L'Engle, Madeleine (1918-), is an American author best known for her children's books. She won the Newbery Medal in 1963 for *A Wrinkle in Time* (1962), a time travel adventure. She wrote two sequels, *A Wind in the Door* (1973) and *A Swiftly Tilting Planet* (1978). All three novels explore the conflict of good and evil as well as family relationships. L'Engle's other children's novels exploring family life include five about the Austin family—*Meet the Austins* (1960), *The Moon by Night* (1963), *The Twenty-Four Days Before Christmas* (1964), *The Young Unicorns* (1968), and *A Ring of Endless Light* (1980). L'Engle's novels for adults include *The Small Rain* (1945) and *A Severed Wasp* (1983), both dealing with a concert pianist. *A Circle of Quiet* (1972), *The Summer of the Great-Grandmother* (1974), and *Two-Part Invention* (1988) are autobiographies. L'Engle was born in New York City.

Length. See Measurement; Metric system; Weights and measures.

Lenihan, Brian (1930-   ), an Irish lawyer and politician, was *tánaiste* (deputy prime minister) and minister of foreign affairs of the Republic of Ireland from 1987 to 1989. He had been foreign minister for two months in 1973 and from 1979 to 1981. He was also agriculture minister from March 1982 to December 1982.

Lenihan was first elected to the Irish parliament, *Dáil Éireann,* in 1961 and served in the Fianna Fáil government of 1964-1973 as minister for justice, education, and transport and power. He was deputy leader of Ireland's Fianna Fáil Party from 1983 to 1990. Brian Joseph Lenihan was born at Dundalk and educated at University College, and King's Inns, Dublin.

Lenin, V. I. (1870-1924), founded the Communist Party in Russia and set up the world's first Communist Party dictatorship. He led the October Revolution of 1917, in which the Communists seized power in Russia. He then ruled the country until his death in 1924.

Lenin believed in the theories of Karl Marx, a German social philosopher. According to Marx, the *free enterprise system,* which is based on privately owned business, would eventually destroy itself. At first, industry and businesses would grow, and the owners would get rich. But the owners would pay such low wages to their workers that the workers would be unable to buy the goods that the system produced. As a result, economic depressions would occur. The depressions would worsen until the workers would revolt and take over the industries. Then, the workers would own the factories and the other means of production, and social classes would no longer exist.

Marx believed that such revolutions would occur in Western nations that had highly developed economies. But he was uncertain if Russia would experience a revolution. Lenin, however, was convinced that it would. But according to Lenin, workers and peasants could not carry out a revolution by themselves. He believed that a revolution would succeed only if led by a small political party of professional revolutionaries. This idea was Lenin's most important addition to Marx's social theory. After the revolution, the party would control the government and build a classless Communist society.

Lenin established a pattern for Communist revolutions. First, he used force to take control of the government. Then, he ruled as a dictator, banning all other political parties and all anti-Communist speeches and publications. After coming to power in Russia, Lenin hoped that other Communist revolutions would overthrow the governments of other countries. For this reason, he tried to help Communist movements in other nations. He thus formed and directed an international organization of Communists called the Comintern (Communist International).

Lenin was absolutely devoted to his Communist goals. However, he also dealt realistically with the political problems he faced. For example, Lenin tried to establish peaceful relations with governments opposed to Communism if such governments were too strong to be overthrown. He also permitted some private enterprise in Russia. This policy allowed the nation's economy to recover from its depressed state after the Communist revolution. Lenin was strongly opposed to all religions. But because so many Russian citizens had religious beliefs, he did not try to close all the churches.

Lenin set up the world's first Communist dictatorship.

Today, Communists consider Lenin and Marx their greatest heroes. Communists continue to draw on and quote Lenin's words as a basis for their actions. His works are also studied in non-Communist countries to provide an understanding of Communism. Lenin is often thought of only as a man of action. Some of his ideas, however, have had considerable influence on political thought in some countries and rank among the most powerful forces of modern times.

For a discussion of Communism and conditions in Russia during Lenin's time, see the articles **Communism** and **Union of Soviet Socialist Republics** (History).

Early life

Boyhood. Lenin was born on April 22, 1870, in Simbirsk (now Ulyanovsk), a quiet town on the Volga River.

Important dates in Lenin's life

1870 (April 22) Born in Simbirsk, Russia.
1891 Graduated from St. Petersburg University.
1897 Exiled to Siberia for political activities.
1898 (July 22) Married Nadezhda Krupskaya.
1900 Returned from exile and went to Western Europe.
1903 Became leader of the Bolsheviks.
1905 Returned to Russia and engaged in revolutionary activity.
1908-1917 Conducted revolutionary activities abroad.
1917 Returned to Russia and led the October Revolution.
1917 (Nov. 8) Became ruler of Soviet Russia.
1918 Shot by Dora Kaplan and recovered.
1918-1920 Led the Bolsheviks in the Russian civil war.
1921 Introduced the New Economic Policy.
1924 (Jan. 21) Died in Gorki, a small town near Moscow.

His real name was Vladimir Ilyich Ulyanov. He adopted the name *Lenin* in 1901. The name may refer to the Lena River of Siberia.

Lenin's father, Ilya Nikolayevich Ulyanov (1841-1886), was a teacher who became director of schools in Simbirsk province. Lenin inherited his father's dark complexion, high cheekbones, and dark brown eyes. His mother, Maria Aleksandrovna Blank (1835-1916), was the daughter of a doctor. She was an educated woman and was highly devoted to her children. Lenin had two brothers and three sisters. All the children, except one sister who died at the age of 20, became revolutionaries.

Lenin had a pleasant childhood. He often imitated his brother Alexander, who was four years older. Lenin swam, hiked, fished, hunted, and played chess. His sister Anna recalled that he had no close friends.

Education. Lenin learned to read when he was 5 years old. He was taught by a teacher who came to the Ulyanov home. Lenin entered school in 1879, at the age of 9, and became a brilliant student.

During Lenin's youth, Russia was generally quiet and peaceful. The Russian government was an *autocracy,* a system in which one man holds supreme power. Czar Alexander III had come to power in 1881 after the murder of his father, Alexander II. Russia was rapidly becoming an industrial country, though living standards remained low.

In 1886, Lenin's father died. In 1887, Lenin's brother Alexander was hanged for taking part in an unsuccessful plot to kill the czar. The tragedy deeply influenced Lenin. At his trial, Alexander said he had wanted to kill the czar to gain "political freedom" for the Russian people.

In 1887, the year his brother was hanged, the 17-year-old Lenin finished school. He won a gold medal for excellence in studies. In the autumn of 1887, Lenin enrolled in the law school at Kazan University in Kazan. He was expelled three months later for taking part in a student meeting protesting at the lack of freedom in the school. Lenin unsuccessfully applied several times for permission to reenter. In 1890, St. Petersburg University admitted Lenin as a student, but he was not permitted to attend classes. However, he was allowed to study on his own and to take examinations.

Lenin received a law degree from St. Petersburg University in 1891, and joined a law firm in Samara. He was now absorbed in the study of Marxism. In 1893, Lenin joined a Social Democratic group, a Marxist organization. Later that year, he moved to St. Petersburg, and became an active revolutionary. In those days, St. Petersburg was Russia's capital.

Young revolutionary. In St. Petersburg, Lenin soon became a leader of a Marxist, or Social Democratic, revolutionary group. Lenin had the qualifications for leadership. He was highly intelligent and well educated. His writing was accurate, detailed, and clear.

Czar Alexander III died in 1894, and his son, Nicholas II, became czar. Between April and September 1895, Lenin travelled to France, Germany, and Switzerland to contact other Marxists. In December, Lenin was arrested in St. Petersburg by the czar's police while preparing a revolutionary newspaper, *The Workers' Cause.* After being held for questioning for more than a year, Lenin was *exiled* (expelled) to Siberia in 1897.

Exile in Siberia did not mean imprisonment. The government paid Lenin a small allowance, and he rented quarters in Shushenskoye near Abakan. Lenin enjoyed much freedom and continued his revolutionary writings. On July 22, 1898, Lenin married Nadezhda Konstantinovna Krupskaya (1869-1939), another exiled revolutionary. The couple had no children. While in Siberia, Lenin wrote one of his leading works, *The Development of Capitalism in Russia* (1899).

Revolutionary leader

Beginnings of revolution. In 1898, while Lenin was in exile, a number of secret Marxist groups in Russia joined and formed the Russian Social Democratic Labour Party. After Lenin's exile ended in January 1900, he got permission from the government to leave Russia. He went to Germany to help found the party newspaper, *Iskra* (Spark). *Iskra* was an illegal paper that had to be smuggled into Russia. The editors of *Iskra* also published *Zarya* (Dawn), which dealt with Marxist theory. It was in *Zarya* in 1901 that Vladimir Ulyanov began using the name *Lenin.* Many revolutionaries changed their names to confuse the police.

In 1902, Lenin wrote *What Is to Be Done?* This pamphlet described his ideas on party organization. In 1903, the Russian Social Democratic Labour Party split into two groups, apparently over a dispute about membership. Lenin became the leader of the *bolshinstvo* (majority), or, as this group came to be known, the *Bolsheviks.* The other group became known as the *menshinstvo* (minority), or *Mensheviks.*

The Bolsheviks wanted party membership limited to a small number of full-time revolutionaries. Lenin and his followers believed that for the revolution to succeed, trained professionals should lead the party, and the party should organize the *proletariat* (workers). The Mensheviks, on the other hand, wanted fewer restrictions on party membership and preferred democratic practices to dictatorship.

Revolt. By the early 1900's, a spirit of revolt against Czar Nicholas II had developed in Russia. The citizens wanted more political freedom, land for the peasants, social legislation and higher wages for the workers, greater representation in the government, and an end to the war that Russia was fighting with Japan.

On Sunday, Jan. 22, 1905, Father George Gapon, a Russian Orthodox priest, organized about 200,000 people for a peaceful march on the Winter Palace in St. Petersburg. The unarmed marchers planned to present their requests to the czar. Troops fired on the crowd and killed or wounded hundreds of people. This *Bloody Sunday* caused more revolutionary unrest.

By autumn, strikes had paralysed the country. These troubles led the czar to grant citizens an elected parliament and such basic rights as freedom of speech and the right to vote. The czar also pardoned all political exiles. Lenin returned to Russia in November and called for a general revolt.

A mass strike began in Moscow on December 20, and was followed by strikes in other cities. Soon the strike developed into a full-fledged revolution. By the end of December, the revolution was crushed. Years later, Lenin declared that "without the general rehearsal of 1905, the victory of the October Revolution of 1917 would have been impossible."

Outcast. From 1906 to 1908, Lenin spent most of his time writing revolutionary pamphlets and attending party congresses in England, Germany, and Sweden. Lenin found it too difficult to carry on revolutionary activities in Russia. After two years in Finland, he went to Switzerland and then to France. His main purpose was to keep the Bolshevik organization together. Lenin also tried to further the separation between the Bolsheviks and the Mensheviks. He claimed that the Mensheviks were not real revolutionaries.

In April 1912, in St. Petersburg, several Bolsheviks established *Pravda* (Truth), a revolutionary newspaper that was sold openly. To be closer to Russia, Lenin moved to Kraków (then in Austria-Hungary, now in Poland) and became *Pravda*'s chief contributor.

World War I began during the summer of 1914. Germany declared war on Russia on August 1. The Austrian government arranged for Lenin to go to Switzerland, which did not take part in the war.

Some Russian revolutionaries wanted a Russian victory. Others wanted peace without victory for any country. Lenin said that he wanted Russia to lose the war because a defeat for Russia would bring about a revolution in that country. The German government, which was not revolutionary, secretly gave financial help to Lenin's party. By this means, the Germans hoped to weaken the Russian war effort.

The road to power

The February Revolution. By 1917, Russia had lost many battles in the war. Unrest in the nation mounted, and food shortages were unchecked. The value of Russian money went down. Early in March (February on the old Russian calendar), bread supplies ran short in Petrograd (St. Petersburg). Long lines of women appeared before the bread shops. Russian workers went on strike. By March 9, about 200,000 strikers were demonstrating in Petrograd, the capital. The soldiers refused to maintain law and order. *Soviets* (councils) of workers and soldiers had sprung up in Russia during the revolution of 1905. On March 12, 1917, a group called the Soviet of Workers' and Soldiers' Deputies was established in Petrograd.

Czar Nicholas II gave up the throne on March 15, and a democratic government was established. Prince George Lvov, a Russian political leader, became prime minister. For a time, the Petrograd soviet shared control of Russia with the government. But the Bolsheviks soon demanded "all power to the soviets."

Return from exile. The Bolsheviks were disorganized at the time of the February Revolution. Some of them wanted to accept the Lvov government and end the feud with the Mensheviks. Others opposed both the Lvov government and the Mensheviks.

Lenin, still in Switzerland, sought to return to Russia. The Germans were willing to let Lenin travel through Germany on the way to Russia. But they also were afraid that, while in Germany, he might stir up German workers. For this reason, the Germans made Lenin stay inside a single railway carriage while making the trip through Germany. Lenin arrived in Petrograd on April 16, 1917.

In Petrograd, Lenin called for the overthrow of the Lvov government and for an end to Russia's participation in World War I. Lenin quickly regained leadership of the Bolsheviks, but he was unable to seize control of the Lvov government. In July 1917, following an unsuccessful Bolshevik uprising, the government was reorganized under Alexander Kerensky. On July 19, the government ordered Lenin's arrest as a German agent. Lenin fled to Finland.

Lenin's powerful speeches persuaded the Russian people to follow his leadership. Leon Trotsky, also a Bolshevik leader stands on the platform steps.

While living in Finland, Lenin wrote *The State and Revolution* (1917), one of his most important works. He told how to organize a revolution and what kind of government to establish after the power had been seized. In September 1917, Lenin wrote to the leaders of the Bolsheviks and declared that the time for speechmaking was over. It was time for action. "History will not forgive us if we do not assume power now," Lenin said.

The October Revolution. In October 1917, Lenin returned to Petrograd. He urged the Central Committee to begin a revolt immediately. Kerensky's government and leadership were weak. Leon Trotsky, the Bolshevik president of the Petrograd soviet, gained control over some government troops. Naval crews also agreed to support the revolt. The Bolsheviks decided to act.

With little violence, the Bolsheviks seized Petrograd on November 7 (October 25 on the old Russian calendar). Kerensky fled. The struggle for Moscow was more violent than in Petrograd, but by November 15, the Bolsheviks also held that city. Henceforth, the Bolsheviks controlled the Russian government. They had come to power with the help of a simple slogan: "Bread, peace, land." This slogan had little to do with the theories of Marx. But it had real meaning to starving families, soldiers sick of war, and peasants hungry for land.

Lenin the dictator

The Second All-Russian Congress of Soviets opened on Nov. 8, 1917, with delegates from most parts of the country. The congress, controlled by the Bolsheviks, appointed a Council of People's Commissars. Lenin was made chairman of the council and thus became head of the new Russian state. At Lenin's first appearance before the congress, he requested permission to ask Germany for a three-month truce. He also asked for the abolition of private land-ownership. The congress approved both requests. The Bolsheviks started peace talks with Germany, and *nationalized* (put under government control) all privately owned land.

Lenin hardly had time to begin nationalizing industry, banks, and private business, when he found himself battling to stay in power. The Russian Army had fallen apart, the Germans were advancing into Russia, and forces that opposed the Bolsheviks were gathering in many parts of the country.

Lenin insisted on ending the war with Germany at any price. He believed that such action was necessary if the Bolsheviks were to stay in power. On March 3, 1918, Russia and Germany signed the treaty of Brest-Litovsk. The treaty required Russia to give up Finland, Poland, Bessarabia, the Ukraine, and the Baltic States—Estonia, Livonia (now Latvia), and Lithuania. The Germans agreed to allow the Russian government to continue ruling the rest of Russia. On March 12, Lenin moved the capital of Russia from Petrograd to Moscow, partly so that his government would be farther from German power. After Germany lost World War I in November 1918, the treaty of Brest-Litovsk became invalid.

In 1918, at Lenin's suggestion, the Bolsheviks changed the name of the Russian Social Democratic Labour Party to the Russian Communist Party (Bolsheviks).

Rule by terror. In December 1917, Lenin signed the decree that established the *Cheka,* a political police force, and set up rule by terror. People opposed to the Bolshevik government were imprisoned, murdered, or sent to the *Gulag,* a system of prison labour camps where many prisoners died. In July 1918, the Bolsheviks killed Czar Nicholas II and his family. Lenin described his dictatorship as "power, based directly upon force, and unrestricted by any laws."

On Aug. 30, 1918, after speaking to the workers at a Moscow factory, Lenin was shot by Dora Kaplan, a member of the Social Revolutionary Party. Lenin was hit by two bullets, but recovered in several weeks. Kaplan was executed. To discourage other attempts, the Bolsheviks executed hundreds of so-called "hostages."

Civil war. The revolution had spread quickly in the large cities of central Russia. But resistance in distant regions developed into civil war. In January 1918, Lenin formed the Red Army. It was named after the colour of the flag of the world Communist movement. The forces opposing the Reds became known as the Whites. The Whites included revolutionaries, democrats, Russian nationalists, and those who preferred the old government. The Whites were unable to organize effectively. By 1920, the Bolsheviks had won the civil war.

The Russian economy had collapsed. Industrial output was at the vanishing point. Agricultural production had fallen disastrously. People in the cities were starving. Millions of Russians had died or had fled abroad. But the Communist government survived.

Even during the civil war, Lenin did not lose sight of his goal of Communist world revolution. In 1919, he had organized the Comintern to run Communist parties in all parts of the world. The organization also helped gain international support for the Bolsheviks during the civil war. In 1920, Lenin tried to export the revolution by military means by way of Poland to Central Europe.

After the civil war, Lenin took extreme measures to keep control of his weakened country. In March 1921, he introduced a programme called the New Economic Policy. This programme replaced many of the socialist measures started at the beginning of his rule. Small businesses were permitted to resume limited operations. Free retail trade was allowed again. Foreign businesses were invited to invest in Russia. Peasants were

Lenin's tomb, *foreground,* attracted thousands of visitors to Red Square in Moscow each day before the Communists lost control of the Soviet government. The memorial contains a glass-covered casket that holds Lenin's embalmed body.

allowed to sell food to private customers. Food supplies sent by the American Relief Administration saved hundreds of thousands of starving Russians. The commission was headed by Herbert Hoover, who later became president of the United States.

Before 1921, Lenin had asked England, France, Germany, and the United States for credit, trade, and diplomatic recognition. But these nations were unwilling to deal with the Bolshevik government, which had refused to pay Russia's debts and which favoured a worldwide Communist revolution. By 1919, no major country maintained diplomatic relations with the Russian government. But after the New Economic Policy was begun, most European states resumed diplomatic relations.

Death. Lenin's health had been shattered by the strain of revolution and war. He was ill by November 1921. In May 1922, Lenin suffered a stroke but worked on. Lenin was concerned about the direction that the revolution was taking. He challenged some basic ideas of the Bolshevik government. Lenin opposed the concentration of power in government bureaus. He also feared Russian nationalism. Shortly before his stroke, he had appointed Joseph Stalin general secretary of the party. Now, Lenin had serious doubts about Stalin, who was reaching out for purely personal power.

In December 1922, the Bolshevik government established the Union of Soviet Socialist Republics (U.S.S.R.). That same month, Lenin suffered a second stroke. In January 1923, he warned that Stalin was "too rude" and lacked the talents necessary for party leadership. Lenin wrote that he planned to remove Stalin as party secretary. On March 9, 1923, he had a third stroke and lost his power to speak clearly. From this time on, he required constant care. His illness kept him from appointing a new party secretary. Stalin went on to rule the Soviet Union as a dictator from 1929 until 1953.

Lenin died of a brain haemorrhage on Jan. 21, 1924. The government preserved his body and placed it on display. Lenin's tomb, in Red Square, became one of the Soviet Union's most honoured monuments during the Communist era. Thousands of visitors daily passed by the glass-enclosed coffin to view the founder of the Soviet Communist state. But in August 1991, the Communists lost control of the Soviet government, and in December of that year, the Soviet Union broke up into a number of independent states. The fall of Communism unleashed proposals for removing Lenin's body from public display. Many people favoured burying Lenin in a cemetery next to his mother's grave, the spot that Lenin himself had requested as his final resting place.

Related articles in ***World Book*** include:

Alexander III (czar)
Bolsheviks
Communism
International, The
Kerensky, Alexander F.
Krupskaya, Nadezhda K.
Marx, Karl
Mensheviks
Moscow
Nicholas II (czar)
Politburo
Propaganda (History)
Stalin, Joseph
Trotsky, Leon
Union of Soviet Socialist Republics (History)
World War I

Leningrad. See **Saint Petersburg.**

Lennon, John (1940-1980), was a founding member of the Beatles, the most popular group in the history of rock music. Lennon and Paul McCartney wrote most of the Beatles' music. Lennon also played rhythm guitar and piano, and sang. Beatles songs written primarily by Lennon include "Help!" (1965), "All You Need Is Love" (1967), and "A Day in the Life" (1967).

John Lennon

The Beatles disbanded in 1970, but Lennon continued to compose and perform, both as a solo artist and with Yoko Ono and the Plastic Ono Band. Ono married Lennon in 1969 and was his creative partner for the rest of his life. Lennon became known as one of rock's leading social critics through such songs of idealism as "Give Peace a Chance" (1969) and "Imagine" (1971).

John Winston Lennon was born in Liverpool, England, and moved to the United States in 1971. In 1980, Lennon and Ono released *Double Fantasy,* his first album in five years. On December 8 of that year, Lennon was shot to death outside his New York City apartment by a man named Mark David Chapman.

See also **Beatles.**

Lenoir, Jean Joseph Étienne (1822-1900), a Belgian-born French inventor, built the first practical internal combustion engine in 1860. This single-cylinder engine resembled a steam engine, but used street-lighting gas for fuel and had a storage-battery ignition system. Lenoir's engine started more quickly and easily than a steam engine and was more convenient to use. About 500 of the engines were sold.

Lenoir used one of his one-horsepower engines to power a crude motor vehicle, and a two-horsepower engine to drive a boat. But his engines used much fuel and lubricating oil, and the ignition system did not work well. Lenoir died in poverty.

See also **Car** (The petrol car); **Petrol engine** (Development).

Le Nôtre, André (1630-1700), a French landscape designer, created most of the famous gardens of his day. These included Kensington Gardens and St. James's Park in London; Versailles, Saint-Cloud, Fontainebleau, Vaux, and Chantilly gardens in France; and the Quirinal and the Vatican gardens in Rome. He used sculpture to create effects of grandeur. Le Nôtre considered the Chantilly garden his finest work. He was born in Paris.

Lens is a piece of transparent material that has at least one curved surface. Lenses *refract* (bend) light rays and in doing so can form images of an object. The images may be larger, smaller, or the same size as the object itself. Scientists sometimes use lenses to concentrate or spread a beam of light.

Lenses are an important part of eyes. They enable the eyes to form sharp images of both near and distant objects. Lenses in the form of glasses and contact lenses are used to correct imperfections in eyesight. They are also an essential part of binoculars, cameras, microscopes, projectors, telescopes, and other devices.

Artificial lenses are made of glass, plastic, or a transparent crystal such as *quartz.* Quartz is used to refract *ultraviolet rays,* an invisible form of light.

There are two kinds of simple lenses, *converging*

A plano-convex lens has one plane surface and one convex surface. It is used in certain types of slide projectors.

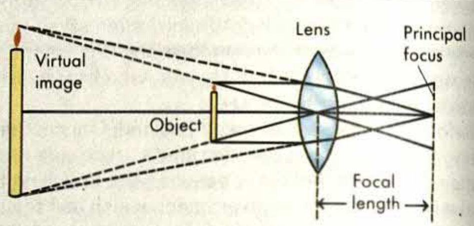
A plano-concave lens has one plane surface and one concave surface. It is combined with other lenses for cameras.

A double-convex lens has two convex surfaces. It is used in magnifying glasses and microscopes.

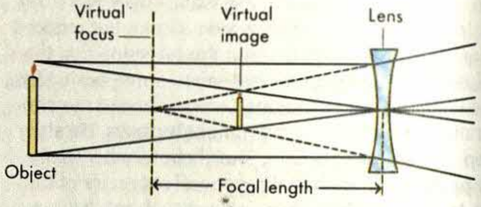
A double-concave lens has two concave surfaces. This type of lens is used in reducing glasses.

A concavo-convex lens has one convex surface of greater curvature than the concave surface. It is thicker in the middle and corrects longsightedness.

A convexo-concave lens has one concave surface of greater curvature than the convex surface. It is thicker at the sides and corrects shortsightedness.



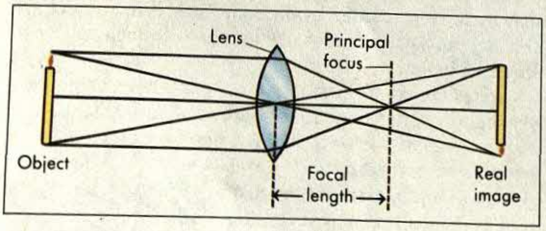
A virtual image can be formed by a convex lens, *above.* A virtual image is always right side up and on the same side of the lens as the object. With convex lenses, it is always larger than the object. A concave lens can form only a virtual image, *below.* With concave lenses, the virtual image is always smaller than the object.



lenses and *diverging lenses.* They differ in the way they are curved and therefore in the manner in which they refract light. *Compound lenses* consist of two or more simple lenses fitted together.

Converging lenses, also called *positive lenses* or *convex lenses,* are thicker in the middle than at the edges. When parallel rays of light pass through this type of lens, they are bent inward and meet at a point called the *focus.* The distance from the centre of the lens to the focus is known as the *focal length.*

The size, position, and type of image produced by a converging lens vary according to the distance of the object from the lens. If an object is more than one focal length from the lens, an inverted *real image* of it is formed on the opposite side of the lens. A real image is one through which light rays from an object actually pass and which can be focused on a screen. When an object is located a distance of two focal lengths from a converging lens, the image is the same size as the object and is located a distance of two focal lengths on the opposite side of the lens. A smaller image of the object can be obtained by moving the object more than two focal lengths from the lens. A larger image can be produced by placing the object between one and two focal lengths from the lens.



A real image can be formed by a convex lens if the object is more than one focal length from the lens. A real image is always upside down and on the opposite side of the lens. It is the same size as the object if the object is twice the focal length away.

If an object is less than one focal length from the lens, a magnified *virtual image* is formed behind the object and is right side up. Light rays from an object do not actually pass through a virtual image, and such an image cannot be focused on a screen.

Diverging lenses are also called *negative lenses* or *concave lenses.* Diverging lenses are thicker at the edges than they are at the centre. Light rays passing through a diverging lens are bent outward. Diverging lenses form only virtual images. The images are always right side up and reduced in size.

Compound lenses. Simple lenses generally produce *aberrated* (imperfect) images. These imperfections in image formation can be reduced through the use of compound lenses. For example, diverging lenses are often used to correct aberrations produced by converging lenses. See **Aberration.**

Related articles in *World Book* include:

Astigmatism
Binoculars
Camera
Contact lens
Eye
Glasses
Magnifying glass
Microscope
Refraction
Telescope

Lens, Contact. See **Contact lens.**

Lent is a religious season observed in the spring by Christian churches. It serves as a time of spiritual discipline and renewal in preparation for Easter. Many churches hold special worship services during the season. Besides attending these services, Christians observe Lent with fasting, prayer, and self-sacrifice.

Lent begins on Ash Wednesday in many churches. In the Eastern Catholic and Eastern Orthodox Churches, Lent begins on a Monday, which is sometimes called *Pure Monday* or *Clean Monday.* The Lenten season lasts approximately 40 days, excluding Sundays in Western churches, excluding Saturdays and Sundays in Eastern churches. The number 40 recalls Jesus' 40-day fast in the wilderness, as described in the Gospels. Most churches reserve special observance of Jesus' *Passion* (suffering and death) for the last week of Lent, called Holy Week.

The word *Lent* comes from words meaning *spring* and *long* and probably refers to the lengthening of days as spring approaches. Lent probably grew out of the early Christian church's practice of baptizing people at the Easter Vigil, a service held on the eve of Easter. During the Vigil, the church also accepted repentant Christians back into the faith. In the weeks before Easter, candidates for baptism fasted and received religious instruction. By the A.D. 900's, Lent had become a time of penance and preparation for Easter for all Christians. The observance of Lent was set at 40 days in the A.D. 600's.

See also **Ash Wednesday; Easter; Holy Week; Palm Sunday.**

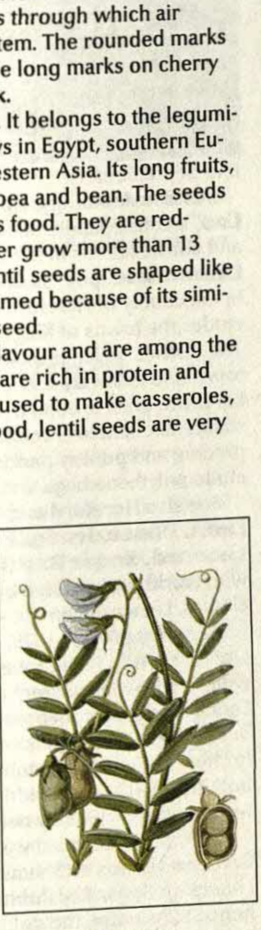
Lenticel is a round or long swelling on the bark of woody stems and roots that functions as a breathing pore. Lenticels are formed when growth areas develop beneath the *cork* (outer layers of the bark). Each growth area produces a mass of new growing cells. As these cells enlarge, they press against and finally break the outer layer of the bark to form a lenticel. The cells of the lenticel are separated by spaces through which air reaches the inner parts of the stem. The rounded marks on horse chestnut stems and the long marks on cherry bark are lenticels. See also **Bark.**

Lentil is an ancient food plant. It belongs to the leguminous family of plants, and grows in Egypt, southern Europe, the United States, and western Asia. Its long fruits, or pods, look like those of the pea and bean. The seeds of the lentil are the part used as food. They are red-brown, grey, or black, and never grow more than 13 millimetres in diameter. The lentil seeds are shaped like a lens. The lens itself was so named because of its similarity in appearance to a lentil seed.

Lentil seeds have a distinct flavour and are among the most nutritious legumes. They are rich in protein and carbohydrates and are usually used to make casseroles, salads, and soups. As a table food, lentil seeds are very popular in many countries, including India and the Middle East.

The lentil plant grows best in light, dry soil. Plants grown in too rich a soil do not bear many pods. The plant is used as fodder for sheep, horses, and cattle. The lentil, one of the first cultivated food plants, was first grown about 2200 B.C. According to Genesis 25: 34, Esau sold his birthright for a "pottage of lentils."

Scientific classification. The lentil belongs to the pea family, Leguminosae (Fabaceae). It is *Lens culinaris.*


Lentil

Lenz's law is a principle of physics important in the design of electric generators. It was developed by Heinrich F. E. Lenz (1804-1865), a German-born scientist. Lenz's law describes the direction of flow of an electric current generated in a loop of wire when an external magnetic field passes through the loop. The current creates its own magnetic field. Lenz's law states that the current will flow around the loop in a direction such that its own field will oppose any *change* in the external magnetic field. Variations in the total magnetic field through the loop are thereby kept to a minimum. This means that work must be done to generate electricity. Thus, powerful turbines are needed to run generators that supply large amounts of current. But an external magnetic field can also be used as a "brake" to slow down an electric generating mechanism.

Leo I, Saint (400?-461), was elected pope in 440. He was also called *the Great.* Leo is most famous for defending orthodox church theology and for defining papal authority.

Leo was probably born in Tuscany in northern Italy. He exercised more day-to-day power than any previous pope. He devoted much of his reign to extending his control and authority over the bishops of Italy, Gaul, Spain, and North Africa. Leo worked out the *Petrine theory* of papal *primacy* (supreme authority). This theory states that Jesus named Saint Peter as the leader among the original apostles (Matt. 16: 17-19). The theory claimed that Peter's successors, the bishops of Rome, inherited Peter's authority.

Through Leo's work at the Council of Chalcedon in 451, basic doctrines were proclaimed about Jesus Christ, especially about His divine and human natures. These remain in force in most Christian churches.

Leo gained much respect during his reign for persuading Attila, king of the Huns, not to attack Rome in 452. Leo also worked out an agreement with Genseric, leader of the Vandal tribe, that limited the force and destructiveness of a Vandal attack on Rome in 455.

Leo was a gifted and forceful writer, leaving 123 authentic letters and 96 sermons. He was not an original thinker, but he had a great ability to organize and explain the thought of previous popes.

See also **Pope** (The early papacy).

Leo III, Saint (? -816), was elected pope in 795. His methods and personality antagonized the aristocratic Romans who held many offices in the papal government, and they organized numerous plots and rebellions against him. In 799, a gang brutally attacked Leo on a Roman street and he fled Rome to seek protection from his friend and ally, Charlemagne, king of the Franks.

In November 800, Charlemagne himself went to Rome to investigate Leo's problems. However, by then no one would publicly accuse the pope of wrongdoing, though previously charges of *simony* (selling of church offices) and immorality had been made against him. Leo took an oath of innocence and Charlemagne reaffirmed his support. On Christmas Day, 800, Leo crowned Charlemagne emperor of the Romans.

Leo was born in southern Italy. As pope, he was active in church affairs in England and Bavaria and strongly defended the faith against heresy. Leo built and restored many churches in and around Rome.

Leo IX, Saint (1002-1054), was elected pope in 1049. The most significant event of his reign was the diplomatic mission he sent to Constantinople in 1054. His *legate* (representative) excommunicated the patriarch of Constantinople, which marked the beginning of the *schism* (split) between the Western and Eastern churches. See **Eastern Orthodox Churches** (History).

Leo was a vigorous reformer. Shortly after his election, he summoned a *synod* (council) that outlawed *simony,* the buying of religious offices. Simony had been one of the chief abuses within the church. This was the first of a series of reforming synods Leo held in Italy, France, and Germany. He issued decrees against simony, clerical marriage, and many other church problems. His actions increased the prestige of the *papacy* (the office of the pope).

Leo was born in Egisheim, now in France, near Colmar. He was known as Bruno of Egisheim before becoming pope. His feast day is April 19.

Leo X (1475-1521) was pope during the climax of the Renaissance in Rome, but he also faced the beginnings of the Protestant Reformation. Leo was elected pope in 1513. He was a pleasure-loving man and a patron of the arts. He spent lavishly on patronage for scholars, composers, and such artists as Michelangelo and Raphael.

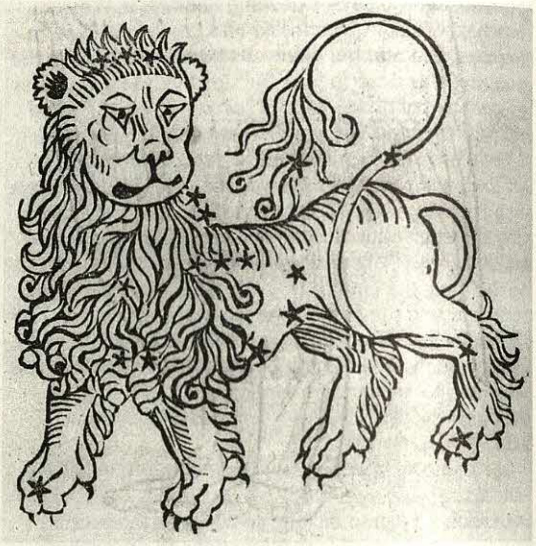
Leo was born in Florence, Italy. His given and family name was Giovanni de' Medici. His father was the powerful Florentine leader Lorenzo de' Medici, also called Lorenzo the Magnificent. During Leo's reign, France and Spain engaged in a long conflict for dominance of Italy. Leo tried to preserve papal *temporal* (nonreligious) power, maintain the independence of Florence, and advance the interests of his family. The Reformation began in 1517. However, Leo was preoccupied with the cultural life of Rome, Italian politics, growing Ottoman power in the Mediterranean, and the election of a Holy Roman emperor in Germany. He was slow to grasp the seriousness of the Protestant religious challenge. The pope's condemnation of Protestant leader Martin Luther in 1520 proved too late to be effective, and the Protestant split from Rome became permanent.

Leo XIII (1810-1903) was elected pope in 1878. His reign was the second longest in papal history. Only Pius IX served longer. Leo wrote many *encyclicals*—that is, letters to the entire Roman Catholic Church. One of the most famous was *Rerum Novarum* (1891), which upheld the rights of workers.

Leo was open to new forms of government, but he still remained suspicious of democracy. In a letter to United States Catholics in 1895, he warned against seeing the American separation of church and state as an ideal for all nations. In 1899, he addressed another letter to the American church condemning *Americanism,* a movement that had many followers in France and Italy. It was an adaptation of such American concepts as religious liberty and the need to adjust the presentation of Catholic teachings to modern ideas and practices. Leo was born in Carpineto, Italy, near Rome. His former name was Gioacchino Vincenzo Pecci.

See also **Roman Catholic Church** (Leo XIII).

Leo, *the Lion,* is the fifth constellation of the zodiac. It forms a large, bright group of stars. Regulus (Alpha Leonis) is a bright, blue-white star, the brightest of the "sickle" curved line of stars, that links the head, mane and forelegs of the lion. Denebola is the brightest of the triangle of stars making up the rest of the main pattern. Other prominent stars in the group are Algieba (Gamma Leonis), a fine, wide *binary* (double) star, and the variable star R Leonis. The constellation also contains four galaxies known as M65, M66, M95 and M96. The Sun passes through the constellation from mid-August to mid-September.



Leo is a group of stars that forms the fifth sign of the zodiac. This illustration is from *Poeticon Astronomical* by Hyginus, published in 1482.

See also **Astrology; Horoscope; Zodiac.**

Leo, a constellation. See **Astronomy** (map: The stars and constellations of the Northern Hemisphere).

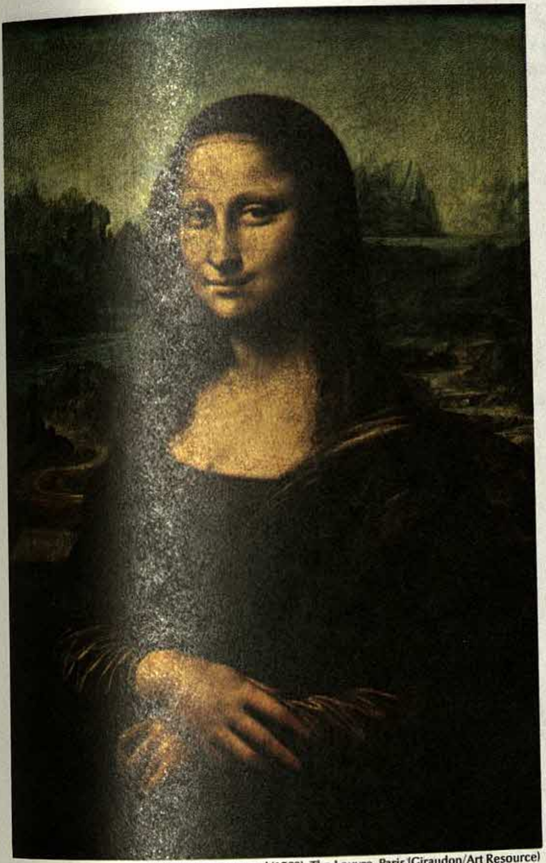
Leominster (pop. 39,000) is a local government district in the county of Hereford and Worcester, England. It includes the towns of Kington, Leominster, and Tenbury. The district, which is mainly agricultural, attracts many tourists to its lovely scenery. Leominster, a historic market town, grew around a priory, whose church still stands. Leominster's economic activities include egg grading and poultry packing. Industrial products include polythene bags and building components.

See also **Hereford and Worcester.**

León, Ponce de.. See **Ponce de León, Juan.**

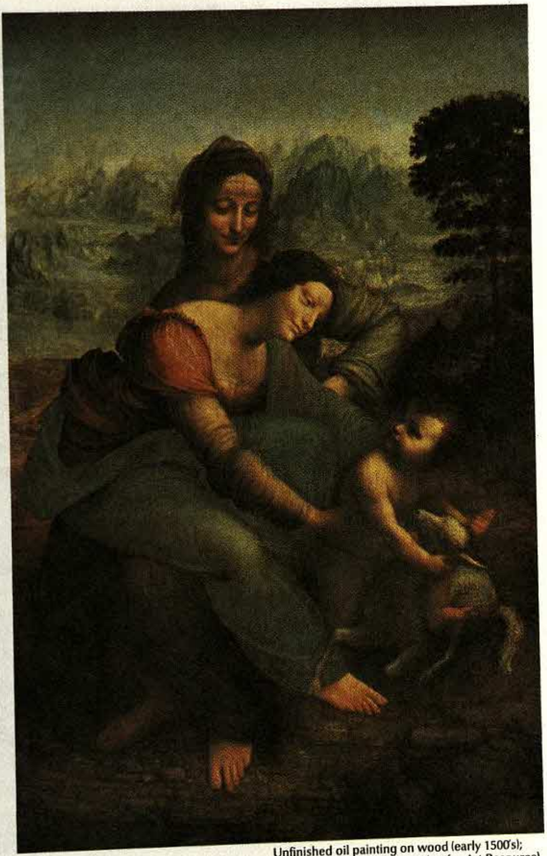
Leonard, Sugar Ray (1956-), an American boxer, won world professional boxing titles in five weight classes. Leonard won the World Boxing Council (WBC) welterweight title in 1979, defeating Wilfred Benitez. He won the World Boxing Association (WBA) junior middleweight title with a victory over Ayub Kalule in 1981. Leonard retired from boxing after eye surgery in 1982, but he made a comeback and defeated Marvin Hagler for the WBC middleweight title in 1987. Leonard won both the WBC super middleweight and light heavyweight titles in 1988 by defeating Donny Lalonde.

Ray Charles Leonard was born in Wilmington, North Carolina. He was nicknamed "Sugar" after former boxing champion Sugar Ray Robinson. He first achieved prominence by winning the gold medal in the light welterweight class in the 1976 Olympic Summer Games.



Oil painting on wood (1503); The Louvre, Paris (Giraudon/Art Resource)

Leonardo da Vinci's *Mona Lisa* is probably the most famous portrait ever painted. Its blurred outlines, graceful figure, dramatic contrasts of dark and light, and overall feeling of calm are characteristic of Leonardo's style.



Unfinished oil painting on wood (early 1500's);
The Louvre, Paris (Erich Lessing for Art Resource)

The Virgin and Child with Saint Anne is arranged in a pyramid shape. Leonardo often used this arrangement.

Leonardo da Vinci

Leonardo da Vinci (1452-1519) was one of the greatest painters and most versatile geniuses in history. He was one of the key figures of the Renaissance, a great cultural movement that had begun in Italy in the 1300's. His portrait *Mona Lisa* and his religious scene *The Last Supper* rank among the most famous pictures ever painted. His scientific work includes accurate drawings of human anatomy.

Leonardo, as he is almost always called, was trained to be a painter. But his interests and achievements spread into an astonishing variety of fields that are now considered scientific specialisms. Leonardo studied anatomy, astronomy, botany, geology, geometry, and optics, and he designed machines and drew plans for hundreds of inventions.

Because Leonardo excelled in such an amazing number of areas of human knowledge, he is often called a universal genius. However, he had little interest in literature, history, or religion. He formulated a few scientific laws, but he never developed his ideas systematically. Leonardo was most of all an excellent observer. He concerned himself with what the eye could see, rather than with purely abstract concepts.

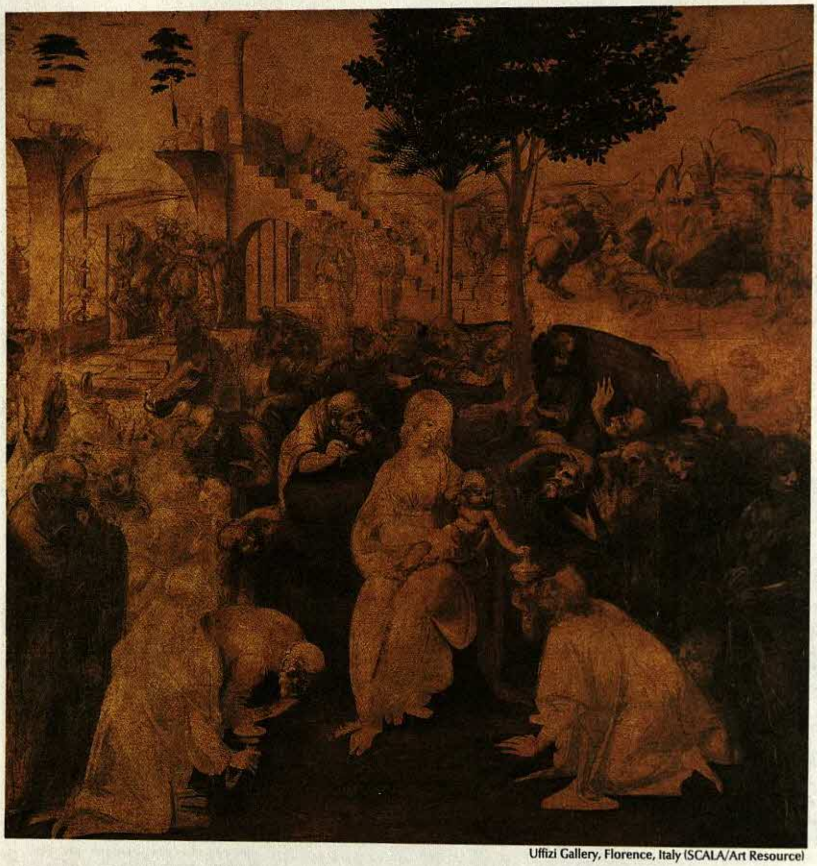
Leonardo's life

Early career. Leonardo was probably born outside the village of Vinci, near Florence in central Italy. The name *da Vinci* simply means *from Vinci.* At that time, Florence and its surrounding villages and farms made up a nearly independent area called a *city-state.* Florence was also a commercial and cultural centre. Leonardo was the illegitimate son of Ser Piero da Vinci, a legal specialist, and a peasant woman named Caterina. Ser Piero's family raised the boy in Vinci.

During the late 1460's, Leonardo became an apprentice to Andrea del Verrocchio, a leading painter and sculptor in Florence. He remained with Verrocchio as an assistant for several years after completing his apprenticeship. Verrocchio and Leonardo collaborated on the painting *The Baptism of Christ* about 1472.

From about 1478 to 1482, Leonardo had his own studio in Florence. During this period, he received an important commission to paint a church altarpiece now known as the *Adoration of the Kings.*

Years in Milan. Leonardo never finished the *Adoration of the Kings* because he left Florence about 1482 to become court artist for Ludovico Sforza, the Duke of



Adoration of the Kings, intended as an altarpiece, was left unfinished after Leonardo worked on it in 1481 and 1482. The artist drew the scene in pen and ink. He used a technique called *metal point* to add precise details with a metal rod much like a pencil. He also brushed on a fine layer of colour called a *wash* to give the scene shading and volume.

Uffizi Gallery, Florence, Italy (SCALA/Art Resource)

Milan. Leonardo lived in Milan until 1499. He had a variety of duties in the duke's court. As a military engineer, he designed artillery and fortresses. As a civil engineer, he devised a system of locks for Milan's canals and designed revolving stages for pageants. As a sculptor, he planned a huge monument of the duke's father mounted on a horse.

About 1483, Leonardo painted the *Madonna of the Rocks.* This painting is his earliest major work that survives in complete form. During the years he lived in Milan, Leonardo also created his famous wallpainting *The Last Supper.*

Return to Florence. In 1499, the French overthrew Ludovico Sforza and forced him to flee Milan. Leonardo also left the city. He visited Mantua, where he made a famous drawing of Isabella d'Este, the wife of the Duke of Mantua. He also visited Venice briefly before returning to Florence.

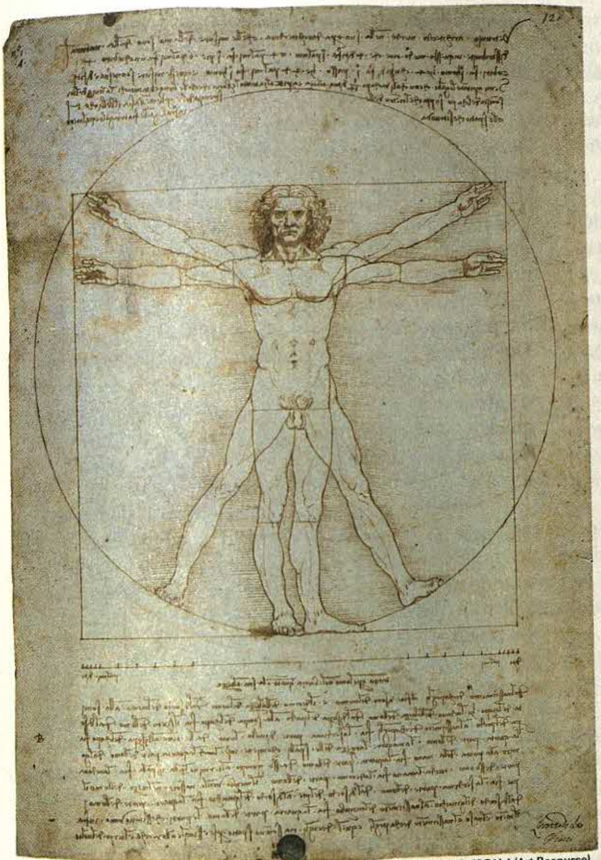
Leonardo's paintings during his stay in Milan had made him famous, and the people of Florence received him with great respect. The early work Leonardo had done in Florence before he left for Milan had strongly influenced a number of young artists, including Sandro Botticelli and Piero di Cosimo. These artists had become the leaders of the next generation of Florentine painters. The work Leonardo was to create after his return to Florence would inspire yet another generation of artists. This generation included Andrea del Sarto, Michelangelo, and Raphael.

When Leonardo returned, Florence was building a new hall for the city council. The Florentine government hired Leonardo and Michelangelo to decorate the walls of the hall with scenes of the city's military victories. Leonardo chose the Battle of Anghiari, in which Florence had defeated Milan in 1440. His painting showed a cavalry battle, with tense soldiers, leaping horses, and clouds of dust.

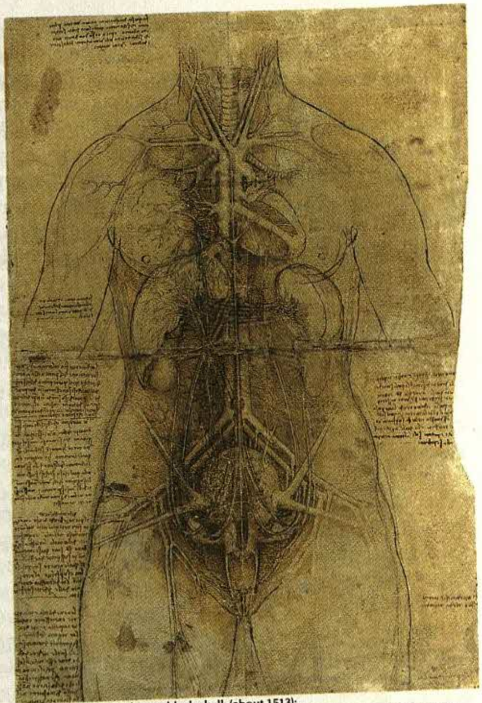
In painting the *Battle of Anghiari,* Leonardo tried an experimental technique that did not work. The paint began to run, and he never finished the project. The painting no longer exists. Its general appearance is known from Leonardo's sketches and from copies made by other artists. About 1503, while working on the *Battle of Anghiari,* Leonardo painted the *Mona Lisa,* probably the most famous portrait ever painted.

Last years. In 1513, Pope Leo X gave Leonardo rooms for his use in the Vatican Palace. Leonardo did little painting during his later years. However, about 1515, he completed *The Deluge,* a series of drawings in which he portrayed the destruction of the world in a tremendous flood. These drawings are the climax of Leonardo's attempts to visualize the forces of life and nature.

Renaissance rulers competed to surround themselves with great artists and scholars. In 1516, Francis I, the king of France, invited Leonardo to become "first painter and engineer and architect of the king." He provided Leonardo a residence connected to the Palace of Cloux at Amboise, near Tours. Leonardo devoted his time to



Pen and ink (about 1492); Accademia, Venice, Italy (SCALA/Art Resource)



Pen and ink over black chalk (about 1513); Windsor Castle (The Royal Collection © Her Majesty Queen Elizabeth II)

Leonardo's scientific drawings include his famous study of human proportions called *Vitruvian man, left,* and an anatomical drawing of a female, *above,* in which Leonardo illustrated the body's circulatory and other systems. Leonardo produced more drawings than any artist before him.

doing anatomical drawings, drafting architectural plans, and designing sets for court entertainments. He died on May 2, 1519.

Leonardo's works

Drawings and scientific studies. Leonardo used drawings both as a tool of scientific investigation and as an expression of artistic imagination. He changed forever the art of drawing. He made drawings in much greater numbers than any artist before him, and he was one of the first artists to use sketches to work out his artistic and architectural compositions. Drawing was indispensable to Leonardo's processes of observation, creation, and invention.

Physical sciences. Leonardo was interested in *mechanics* (the science of motion and force), and many of his ideas and designs were far ahead of their time. For example, he drew plans for aircraft, including a helicopter, and for a parachute. Like many Renaissance artists, Leonardo sometimes worked as an engineer or military architect. He produced designs for a variety of war machines, among them tanks, machine guns, and movable bridges.

Life sciences. Leonardo studied anatomy by dissecting human corpses and the bodies of animals. He made scientific drawings that clarify not only the appearance of bones, tendons, and other body parts, but also their function. These drawings are considered the first accurate portrayals of human anatomy.

Leonardo tried to understand the human body as a mechanism. As his studies progressed, he also tried to understand the forces of life that animated the body. His drawings of anatomy, for example, extended to investigations of human reproduction and embryology and the circulation of the blood. None of these things were understood at the time. His anatomical drawing of a female, which he made about 1508, is his attempt, partly erroneous in detail, to illustrate the body's circulatory and other systems in a single image.

Like other artists, Leonardo was interested in the proportions of the human body. He drew a famous study of human proportions based on the statement of the Roman architect Vitruvius that the "well-shaped man" fits into the perfect shapes of the square and circle. According to Vitruvius, the parts of the body are related to one another in ratios of whole numbers, and these ratios should be used in the design of architecture. Leonardo's drawing of the *Vitruvian man,* done about 1487, is one of the most famous images in European art.

Leonardo also worked to understand the relation between the life of the human body and that of the larger world. For Leonardo, principles of proportion similar to those that shaped the human body also governed the growth of trees, the flight of birds, and the flow of water. When Leonardo drew the leaves of a plant, he intended the lines to show living energy responding to light, water, and soil. The mystery of life was the unifying theme of his work.

Leonardo's notebooks. Leonardo planned to write books on many subjects, including painting, human movement, and the flight of birds, but he never completed any of them. The writings exist in partial drafts and fragments in notebooks. Leonardo's notebooks also include his scientific observations and ideas for inventions, as well as detailed drawings. Most of the notebooks were not published until nearly 400 years after Leonardo's death. By the time his scientific and technical investigations became widely known, other people had come up with the same ideas.

Paintings. For much of his life, Leonardo was interested in optics, which is concerned with the properties of light. Leonardo carefully analysed such things as the pattern of light and shadow on a sphere before a window. The understanding he gained from such study is evident in the rich effects of light, dark, and colour in such paintings as the *Mona Lisa* and *The Virgin and Child with Saint Anne* (early 1500's).

Leonardo also explored the techniques of perspective, which painters use to create an illusion of depth on a flat surface. Florentine artists began to use these techniques in the early 1400's. *Linear perspective* is based on the optical illusion that parallel lines seem to converge as they recede toward one point, called a *vanishing point. Aerial perspective* is based on the fact that light, shade, and colour change with an object's distance from the viewer.

Early paintings. Verrocchio and Leonardo shared the work of painting *The Baptism of Christ,* which is reproduced in the *World Book* article **John the Baptist, Saint.** Leonardo painted the left angel, the distant landscape, and possibly the skin of Christ. Leonardo's parts of the painting, with their soft shadings and shadows concealing the edges, are an early example of the *sfumato* (smoky) quality of his paintings. Verrocchio's figures, on the other hand, are defined by hard lines typical of early Renaissance painting. Leonardo's more graceful approach marked the beginning of the High Renaissance style, which did not become popular in Italy until about 25 years later.

Leonardo's *Adoration of the Kings* exists today in an unfinished form, with the figures visible only as outlines of contrasting light and dark areas. This kind of composition is called *chiaroscuro,* a word which combines the Italian words for *light* and *dark.* Chiaroscuro is characteristic of the High Renaissance style.

The *Adoration of the Kings* shows three kings worshipping the newborn Christ child. Leonardo abandoned the traditional treatment of this popular subject. Earlier versions showed the figures in profile, with the Virgin Mary and Jesus on one side of the painting and the kings on the other. To give the Holy Family more emphasis, Leonardo placed them in the centre, facing the viewer. The kings and other figures form a semicircle around Mary and Jesus. Leonardo sharply contrasted foreground and background. Strong light-dark contrasts and simple geometric forms were basic features of Leonardo's mature style as a painter.

In the *Adoration of the Kings,* Mary and the Christ child are arranged in a pyramid shape. Leonardo also used this arrangement in other paintings, including the *Madonna of the Rocks* and *The Virgin and Child with Saint Anne.* The *Madonna of the Rocks* is reproduced in the **Painting** article. In *The Virgin and Child with Saint Anne,* pictured with this article, the gazes of all the figures are concentrated on one side of the pyramid, giving it a new psychological and dramatic unity.

The Last Supper. Leonardo finished painting *The Last Supper* about 1497. He created the famous scene on a wall of the dining hall in the monastery of Santa Maria delle Grazie. The painting shows the final meal of Jesus Christ and His 12 apostles. Jesus has just announced that one of them will betray him. *The Last Supper* is reproduced in the article on **Jesus Christ.**

When painting *The Last Supper,* Leonardo rejected the *fresco* technique normally used for wallpaintings. The technique requires an artist to mix dry pigments with water and brush them onto damp, freshly laid plaster. An artist who uses the fresco method must work quickly. But Leonardo wanted to paint slowly, to revise his work, and to use shadows—all of which would have been impossible in fresco painting.

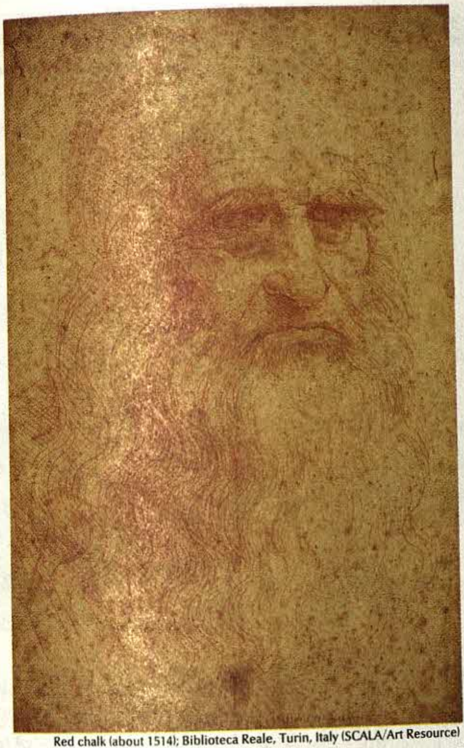
To solve this problem, Leonardo developed a new technique that involved coating the wall with a compound he had created. But the compound, which was supposed to hold the paint in place and protect it from moisture, did not work. Soon after Leonardo completed the picture, the paint began to flake away. *The Last Supper* still exists, but in poor condition, though many attempts have been made to restore it.

Leonardo also changed the traditional arrangement of the figures. Christ and His apostles are usually shown in a line, with Judas, the betrayer, set apart in some way. Leonardo painted the apostles in several small groups. Each apostle responds in a different way to Christ's announcement that one of them will betray Him. Jesus sits in the centre of the scene, apart from the other figures. Leonardo's composition creates a more active and centralized design than earlier artists had achieved. The composition, in which the space recedes to a point behind the head of Christ, is one of the great examples of one-point perspective in Italian Renaissance painting. Leonardo used linear perspective to focus attention on the painting's religious and dramatic centre, the face of Jesus Christ.

Mona Lisa, shown in this article, is probably a portrait of the young wife of a rich Florentine silk merchant, Francesco del Giocondo. *Mona Lisa* is a shortened form of *Madonna Lisa* (my lady, Lisa). The woman is also often called *La Gioconda,* which is the feminine form of her husband's last name.

The portrait shows a young woman seated on a balcony high above a landscape. Leonardo used a pyramid design to place the woman simply and calmly in the space of the painting. Her folded hands form the front corner of the pyramid. Her breast, neck, and face glow in the same light that softly models her hands. The light gives the variety of living surfaces to an underlying geometry of spheres and circles, which includes the arc of her famous smile.

Behind the figure, a vast landscape recedes to icy mountains. Winding paths and a distant bridge give only the slightest indications of human presence. The landscape reflects Leonardo's studies of geology. He was one of the first people to grasp that geological time is revealed in rock layers and to understand such processes as erosion.



Red chalk (about 1514); Biblioteca Reale, Turin, Italy (SCALA/Art Resource)

Leonardo's self-portrait was drawn when he was about 60 years old. It is the only existing likeness of the artist.

Leonardo's importance

Leonardo had one of the greatest scientific minds of the Italian Renaissance. He wanted to know the workings of what he saw in nature. Many of his inventions and scientific ideas were centuries ahead of his time. For example, he was the first person to study the flight of birds scientifically.

Leonardo's importance to art was even greater than his importance to science. He had a strong influence on many leading artists, including Raphael and Michelangelo. Leonardo's balanced compositions and idealized figures became standard features of later Renaissance art. Painters also tried to imitate Leonardo's knowledge of perspective and anatomy, and his accurate observations of nature.

What most impresses people today is the wide range of Leonardo's talent and achievements. He turned his attention to many subjects and mastered nearly all. His inventiveness, versatility, and wide-ranging intellectual curiosity have made Leonardo a symbol of the Renaissance spirit.

Related articles in ***World Book*** include:

Aerodynamics (Pioneers of aerodynamics)
Aeroplane (picture: An early design)
Heart (picture: Leonardo da Vinci)
Helicopter (Early designs and experiments)
Painting (The Renaissance)
Parachute (picture: Leonardo da Vinci)
Renaissance (The fine arts; picture: The drawings of Leonardo da Vinci)

Leoncavallo, Ruggiero (1858-1919), was an Italian opera composer. He is best known for his two-act *Pagliacci* (1892). This opera is a violent tragedy about a group of travelling players in Italy. Its melodramatic form of realism is called *verismo.* Leoncavallo was inspired to write the opera by the success of Pietro Mascagni's one-act verismo opera, *Cavalleria Rusticana* (1890). The two works are usually performed together.

Leoncavallo was born in Naples, and studied music there. He met Richard Wagner in 1876, and decided to imitate the German composer by becoming an opera composer and writing his own texts. Leoncavallo wrote many operas, but none of his other works matched the success of *Pagliacci.*

See also **Opera** (Verismo opera; The opera repertoire [*Pagliacci, I*]).

Leonidas I (? -480 B.C.) was a king of ancient Sparta. Little is known about his life, but his heroic death at Thermopylae is one of the most famous episodes in history (see **Thermopylae**).

Leonidas became king of Sparta about 488 B.C. The Persian king, Xerxes, invaded Greece in 480 B.C., with a large army. Leonidas, with an army of about 6,000 Greeks, tried to stop the Persians at Thermopylae, a narrow pass between mountains and sea. The Greeks held the pass for two days. Then the Persians found a new path over the mountains and threatened the Greeks from the rear. Leonidas sent most of the Greeks to safety in southern Greece, and tried to hold off the Persians with about 300 Spartans and 1,100 other Greeks. He and most of these soldiers were killed.

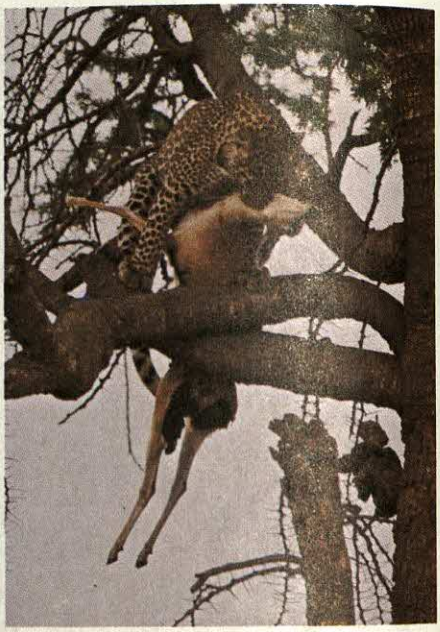
Leonids are meteors that seem to come from the constellation Leo. The *meteoroids* (chunks of matter in space) that cause the Leonids travel around the sun in an orbit that the earth crosses about November 17 each year. They become visible when they enter the earth's atmosphere. In most years, few Leonids are seen. However, heavy Leonid meteor showers occur every 33 years when the earth passes through the thickest part of the meteoroid swarm. The next heavy Leonid shower is expected to occur in 1999.

Leopard is a large member of the cat family. It is the third largest cat of the Eastern Hemisphere. Only the lion and tiger are larger. Leopards live in Africa as far north as the Sahara, and in Asia from Turkey to Korea and Java.

Leopards are graceful, alert, and cunning. They average 70 centimetres high at the shoulder and 2.5 metres long. But a big male may measure almost 2.8 metres from nose to tail and weigh from 45 to 75 kilograms. A big female may weigh about 35 kilograms. Leopards bear two, three, or four young in a litter.

The coat of most leopards is light tan with many dense black spots. The tail has dark rings around it. All leopards are much alike, but those that live in forests are darker than those that live on open plains and desert scrub. The black leopard is so dark that the spots are hard to see. The whole animal looks black. Black leopards are often called *panthers.* Albinos are much rarer than the black variety, which is found in Malaysia, Java, and India.

These fierce animals eat meat and hunt their prey. They feed on such animals as monkeys, antelope, muntjacs, jackals, peacocks, snakes, sheep, goats, and dogs.



The powerful and graceful leopard lives both on the ground and in trees. On the ground, this skilful hunter blends in with the surroundings, *above,* as it stalks its prey. After making a kill, a leopard may drag the animal up a tree, *right,* and store the prey there until it is hungry.

In Africa, they even kill the big porcupines that have quills 30 centimetres or more in length.

Leopards seldom attack human beings. However, once they discover that people are easy victims, leopards may become more dangerous than tigers or lions. Leopards are good climbers and spend part of their time in trees. They are unbelievably strong. Carcasses of prey weighing from 35 to 68 kilograms have been found in trees 4 to 6 metres above the ground where a leopard had carried them.

So many leopards have been killed for their fur that the animals have become rare in many places. Several subspecies face possible extinction. Many countries have signed treaties forbidding trade in leopard skins.

Scientific classification. The leopard belongs to the cat family, Felidae. It is *Panthera pardus.*

See also **Cat; Snow leopard.**

Leopard frog. See **Frog** (Kinds of frogs; picture).

Leopardi, Giacomo (1798-1837), was an Italian lyric poet. He was sickly and physically deformed, and felt lonely and unloved despite the brilliance of his career. His poems are sensitive expressions of the despair he found in living. However, the hopeless tone in his poetry is always softened by hope in the future and an underlying love of life.

Leopardi's verse collections include *Idyls* (1825) and *Songs* (1836). His other important work is *Le operette morali* (*Moral Essays,* 1824-1832). In this series of essays, he reinterpreted historical figures and ancient myths and legends to show their timeless meaning.

Leopardi was born in Recanati. By the age of 16, he had mastered several languages and was writing scholarly essays as well as poetry.

See also **Italian literature** (Romanticism).

Leopold was the name of three kings of Belgium.

Leopold I (1831-1865) became the first king of Belgium after the nation achieved independence from the Netherlands in 1830.

Leopold II (1865-1909) succeeded his father, Leopold I, in 1865. He acted independently of the Belgian government to establish the Congo Free State (now Zaire), a colony in central Africa.

Leopold III (1934-1951) succeeded his father, Albert I, in 1934. As commander in chief of Belgium's armed forces, Leopold surrendered to the invading German army at the start of World War II (1939-1945). His surrender aroused controversy, leading to his abdication in 1951.

See also **Belgium.**

Leopold, Aldo (1886-1948), an American naturalist, won international fame as an authority on wildlife conservation. He was a pioneer in applying the principles of ecology to wildlife management. Leopold, an enthusiastic outdoorsman, believed that people should enjoy wilderness areas as places for recreation.

Leopold wrote a number of books and articles about conservation. His textbook *Game Management* (1933) is considered a classic. *A Sand County Almanac* (1949) and *Round River* (1953) include many of Leopold's philosophic essays on conservation. These essays stress the need for wilderness areas.

Leopold was born in Burlington, Iowa. He graduated from Yale University in 1908 and earned a Master of Forestry degree there the next year. Leopold worked for the U.S. Forest Service from 1909 to 1927. In 1933, he became a professor at the University of Wisconsin.

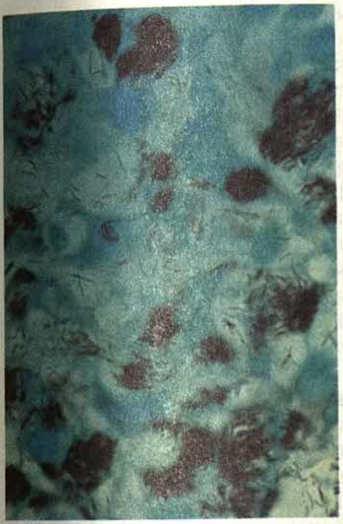
Léopoldville. See **Kinshasa.**

Lepanto, Battle of. See **Navy** (Famous sea battles); **Turkey** (The start of the Ottoman decline); **Cervantes, Miguel de.**

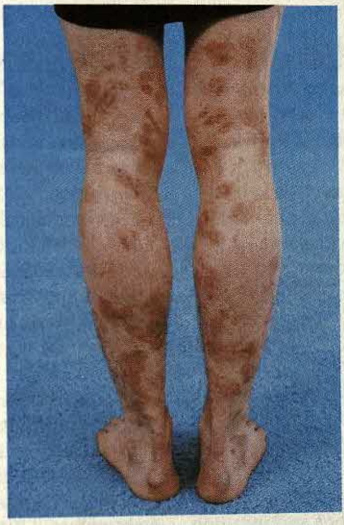
Lepidoptera. See **Insect** (table, pictures: Order Lepidoptera).

Leprechaun. See **Fairy.**

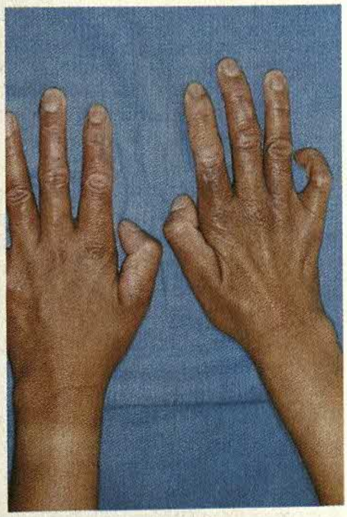
Leprosy, also called *Hansen's disease,* is a chronic infectious disease. It primarily affects the skin; the mucous membranes, especially those in the nose; and the *pe-*



Mycobacterium leprae, a rod-shaped bacterium, causes leprosy. Many appear in this microscopic view.



Skin lesions (white or reddish patches of skin) are a common symptom of leprosy.



Nerve damage from leprosy can weaken hand muscles, making fingers curl inward.

ripheral nervous system, which includes nerves that connect the spinal cord to the muscles. In advanced cases of the disease, the eyes, liver, spleen, muscles, and bone marrow can also be affected. Leprosy is not usually fatal. However, patients with untreated or neglected infections may develop crippling deformities of the hands and feet.

Through the years, people with leprosy have been the victims of fear and prejudice, largely because of the deformities associated with the disease. In many societies, people with leprosy have been made outcasts from their communities.

Causes. Leprosy results from infection by a rod-shaped bacterium called *Mycobacterium leprae,* sometimes known as *Hansen's bacillus.* The Norwegian doctor Gerhard Armauer Hansen first observed *M. leprae* bacteria in tissue specimens from leprosy patients in 1873. The following year, he proposed that the bacteria caused leprosy.

M. leprae infection occurs primarily in human beings. But the bacteria also have been found in armadillos, chimpanzees, and mangabey monkeys. Researchers do not know exactly how the bacteria are transmitted. Most evidence suggests that people become infected by inhaling the bacteria. However, some cases have reportedly resulted from skin-to-skin contact.

Symptoms. Most people who are exposed to *M. leprae* resist infection and develop immunity after this exposure. Only a few actually develop the disease. Symptoms of leprosy typically appear three to five years after infection.

The chief symptoms of leprosy include white or reddish patches of skin, called *skin lesions;* the loss of feeling in the skin lesions; and thickened nerves. The skin may also thicken, and dark *nodules* (lumps) may appear on many parts of the body. If the disease is not treated, nerves can become severely damaged, causing weakness in the hands and feet. As a result, the fingers and toes may curl inward. If *M. leprae* enter the eyes, a painful inflammation called *iritis* can occur. In severe cases, the bacteria can cause blindness.

There are two main forms of leprosy: (1) *tuberculoid* and (2) *lepromatous.* Most patients with the tuberculoid form have only one or a few lesions with few, if any, *M. leprae* detectable in the tissue. Most patients with the lepromatous form have multiple lesions containing billions of bacteria per gram of tissue.

Treatment. No effective, reliable vaccine to prevent leprosy has been developed. However, certain drugs can halt the progression of leprosy and can rapidly make the patient noninfectious. The sulpha drug dapsone has served as the chief medicine used to treat leprosy since the late 1940's. However, by the early 1980's, an alarming number of leprosy cases resistant to dapsone therapy had occurred.

To combat the dapsone-resistant bacteria, doctors treat patients with combinations of two or three drugs. Patients with few lesions and few bacteria per lesion are treated for six months with both dapsone and the antibiotic rifampin. Patients who have many lesions or many bacteria per lesion are treated for two years with dapsone, rifampin, and another drug, clofazimine.

More than $1\frac{1}{2}$ billion people live in areas where leprosy is *endemic* (regularly found). Consequently, in addition to treatment of individual cases, public health measures are needed to combat the disease. For centuries, public health programmes consisted of simply isolating patients and confining them to hospitals called *leprosariums.* This approach probably had little effect on the spread of the disease and did little good for the patient. It also did nothing to remove the fear and prejudice surrounding leprosy, which still hinder relief efforts in many parts of the world today.

Modern control programmes have a twofold emphasis. They stress (1) community-based screening to detect cases of leprosy and (2) educating the community about the disease. Early detection and treatment can halt transmission of *M. leprae* in the community and can greatly reduce development of the disabilities associated with the disease. As a result, many screening programmes include the medical examination of everyone in a school or community and drug therapy for all who are infected. Education of the community concentrates on reducing the fear of leprosy and encouraging infected individuals to seek treatment.

History. Historians do not know where or when leprosy originated. The word *leprosy* appears in the Bible, but probably refers to a number of skin diseases, and not to leprosy alone. The first accurate description of leprosy appeared before A.D. 300 in the writings of the Indian physician Sushruta.

Leprosy entered Europe in the 400's B.C. Some historians think it may have been introduced by the troops of the Persian ruler Xerxes as they invaded Greece in the 400's B.C. The disease spread slowly through the Mediterranean and then to the rest of Europe.

Leprosy reached epidemic proportions in western Europe in the A.D. 1100's and 1200's. It then gradually disappeared from Europe as living conditions and nutrition improved there. However, the disease persisted in Norway until the late 1800's. In the Western Hemisphere, leprosy was unknown until the arrival of European explorers and settlers.

Today, leprosy afflicts 5 million to 6 million people worldwide. It is endemic in tropical or subtropical regions, including Africa, Central and South America, India, and Southeast Asia. Small pockets of the disease can also be found in southern Europe.

See also **Damien de Veuster, Joseph.**

Lepton is one of the three major families of elementary particles. The other families are *quarks* and *bosons.* Most physicists believe leptons are fundamental units of matter—that is, the particles do not consist of smaller units.

Physicists have identified six types of leptons—*electrons, muons, taus,* and three kinds of *neutrinos.* Electrons, muons, and taus have a negative electric charge. Muons and taus have a much larger mass than that of electrons. A muon is about 207 times as heavy as an electron, and a tau is 3,490 times as heavy. No difference has been found between electrons, muons, and taus other than their mass. The three kinds of neutrinos have no electric charge. They are called *electron-, mu-,* and *tau-neutrinos* because each is associated with one type of charged lepton. Their mass has so far proved to be too small to measure.

All leptons have antimatter counterparts called *antileptons.* Antileptons have the same mass as leptons, but all other properties are reversed. Because neutrinos have no charge, their antiparticles also are neutral.

Muons and taus are unstable particles, and so they *decay* (break down) into lighter particles. A muon decays into an electron, a mu-neutrino, and an electron-antineutrino in about 2 millionths of a second. The lifetime of a tau is less than 2 trillionths of a second. A tau, because of its large mass, can decay into many different combinations of lighter particles.

See also **Antimatter; Muon; Neutrino; Particle physics.**

Lerner, Alan Jay (1918-1986), was one of the greatest lyricists of the American musical theatre. His best lyrics display a wit and literacy rare in musical theatre. Lerner's most memorable work was done with Vienna-born composer Frederick Loewe. They first teamed up in 1942, and their greatest success was the musical comedy *My Fair Lady* (1956). They also created the hit musicals *Brigadoon* (1947), *Paint Your Wagon* (1951), and *Camelot* (1960), as well as the film musical *Gigi* (1958). Lerner and Loewe won Academy Awards for the title song, and Lerner won an Academy Award for the film's screenplay.

Lerner collaborated with composers Kurt Weill on *Love Life* (1948), Burton Lane on *On a Clear Day You Can See Forever* (1965), and André Previn on *Coco* (1969). In addition to lyrics, Lerner wrote the *libretto* (dialogue) for many of his musicals. He won an Academy Award in 1951 for writing the screenplay for *An American in Paris.* Lerner was born in New York City.

Lesage, Alain René (1668-1747), was a French novelist and dramatist. He first practised law, but left this career to become a writer. He was among the first to earn his living by writing. Lesage's novel, *Gil Blas* (1715-1735), is a witty satire set in Spain. The story is told in the first person by Gil Blas, who learns to his sorrow that life can be harsh when one has to make one's own way without help. His innocence and vanity make him an easy victim. Lesage was born in Sarzeau, France.

Lesbos, also spelled *Lesvos,* is a mountainous Greek island in the Aegean Sea. It covers 2,154 square kilometres and has about 104,000 people. Mitilini (also spelled Mytilene) is its largest city. The entire island is sometimes called *Mitilini.* The economy of Lesbos is centred around agriculture. The island produces olives, olive oil, grapes, and tobacco. Other economic activities include tourism, soapmaking, and the quarrying of marble.

A local legend says that Lesbos' people descend from the mythological Greek warrior Agamemnon. According to the legend, Agamemnon conquered Lesbos in the Trojan War, which probably took place in the 1200's B.C. From the late 1100's to the 900's B.C., many Aeolians from mainland Greece moved to Lesbos. Lesbos was a major cultural centre from about 600 B.C. to the end of the Golden Age of Greece in 431 B.C. It was the home of the poet Sappho (see **Sappho**). Turks controlled Lesbos from 1462 until Greece annexed it in 1913.

Lesch-Nyhan syndrome is a rare hereditary disease that can cause mental retardation. Lesch-Nyhan syndrome results from a deficiency of *hypoxanthine-guanine phosphoribosyl transferase,* an enzyme found in all body cells. This enzyme is normally present in particularly high levels in the *basal ganglia* of the brain. The basal ganglia help control unconscious body movements. In addition to mental retardation, symptoms of Lesch-Nyhan syndrome include uncontrollable movements and a tendency toward self-mutilation.

Patients inherit the syndrome through a defective gene on the X chromosome, one of the two chromosomes that determine sex. Males have one X chromosome and one Y chromosome, and females have two X chromosomes. A male who inherits the defective gene will develop the disease. But a female develops the disease only when the defective gene occurs on both X chromosomes. A female who carries the defective gene can transmit the defect to her children. Boys who inherit it usually die around the age of puberty.

Lesch-Nyhan syndrome cannot be cured or effectively treated. The disease was first described in 1964 by William Nyhan, an American professor of medicine, and one of his students, Michael Lesch.

Leslie is the name of the first family to establish properties on the Darling Downs of Queensland, Australia.

Patrick Leslie (1815-1881) was born in Scotland. He went to Australia in May 1835, and studied farming and grazing methods with the Macarthur family at Camden, New South Wales. He also bred stud racehorses. Patrick married Catherine Macarthur in 1840. He went to New Zealand in about 1870 and had a property in the Waikato region. He returned to Australia in 1879.

Walter Leslie and **George Leslie,** Patrick's brothers, joined him in January 1840. The brothers tried many experiments, including cotton growing and the introduction of South American llamas.

Leslie, Sir Shane (1885-1971), a British author, wrote poetry, novels, biographies, and works on historical subjects. His biographies and historical works are known for their learning, understanding, and sense of humour. Among these works are *The Life of Cardinal Manning* (1922), *George the Fourth* (1926), and *The Skull of Swift* (1928). Leslie's poetry includes *The Epic of Jutland* (1930) and *Poems and Ballads* (1933). His novels include *The Oppidan* (1922) and *Doomsland* (1923). John Randolph Shane Leslie was born in London.

Lesotho is a rugged, mountainous country that is completely surrounded by the Republic of South Africa. It lies about 320 kilometres inland from the Indian Ocean. Lesotho is sometimes called the *Switzerland of Southern Africa* because of its beautiful mountain scenery. But it is a poor country, with little industry. Many of the people of Lesotho go to South Africa to find jobs.

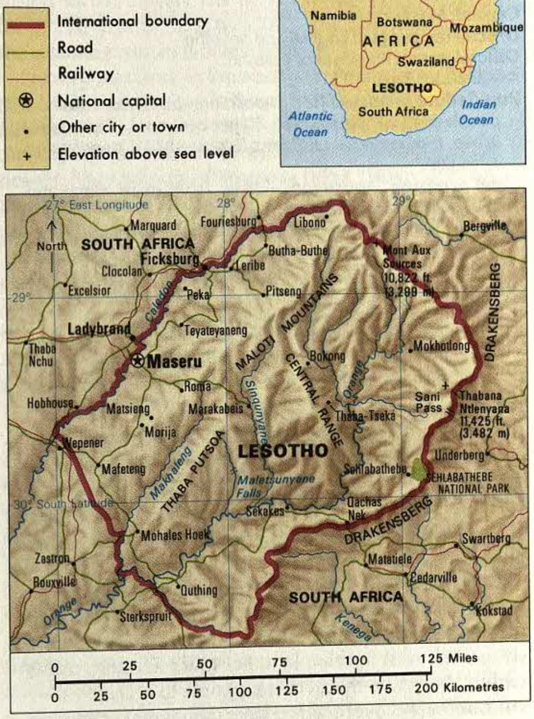
Lesotho was formerly governed by the United Kingdom as the protectorate of Basutoland. It became independent in 1966. Maseru is the capital of Lesotho and the country's largest town (see **Maseru**).

Government. Lesotho is a constitutional monarchy. A king is the head of state. However, the king has no official power. A prime minister and a cabinet carry out the operations of the government. Lesotho's parliament consists of a National Assembly and a Senate. The people elect the 65 members of the Assembly. The Senate consists of 22 local chiefs and 10 other members who are appointed by the prime minister. The prime minister is the leader of the party that wins a majority of seats in the National Assembly. The prime minister appoints cabinet members. Lesotho is divided into 10 administrative districts for purposes of local government. Each district is headed by a district secretary.

People. For Lesotho's total population, see the *Facts in brief* table with this article. Most of the people of Lesotho are *Basotho* (also spelled *Basuto*). Many rear livestock and grow food crops. The wealth of a family is often measured by the number of cattle it owns. Most Basotho live in villages of fewer than 250 people. Family groups build their huts around a cattle *kraal* (pen) with open space separating each group. Traditional huts have mud or turf walls with thatched roofs. The Basotho often paint designs in bright colours on the doors and walls. Wealthy Basotho live in stone houses with roofs of tin or tile. Each village has a *khotla* (meeting place) where men discuss village business.

The Basotho grow crops on the land surrounding the villages. All land is owned in common by the people, and local chiefs assign the land to the people. The women do most of the heavy work on the farms and in the homes. They hoe and weed the land, harvest the crops, and build the houses. The men plough the land and look after the sheep, cattle, and goats. From the time they are 5 or 6 years old, boys herd livestock. On farms in the western plains, they return home with their herds every night. In the eastern highland areas, boys often spend months away from home, moving their flocks and herds in search of fresh pasture.

Lesotho



Maize, sorghum, milk, and vegetables are the chief foods. The women brew sorghum beer. In the 1800's, the Basotho wore clothes made from animal skins. Most of them now wear Western clothes, but they often wrap themselves in multicoloured blankets to keep warm.

English and Sesotho, a Bantu language, are the country's two official languages. The traditional religions of the people are based on ancestor worship (see **Ancestor worship**). But more than 80 percent of Lesotho's people now are Christians.

About 75 per cent of the children in Lesotho attend primary school, and about 65 per cent of the adults can read and write. About two-thirds of all schoolchildren are girls, because many boys spend their youth herding livestock. Missionaries run most of the schools. Lesotho's national university is in Roma.

Land. Most of Lesotho is mountainous. The Drakensberg, a mountain range, rises to over 3,400 metres above sea level in the east. The Maloti Mountains, a part of the Drakensberg, cover much of central Lesotho. The only plains lie in the west. The Orange River rises in northeastern Lesotho (see **Orange River**).

Most of Lesotho has a mild, moist climate, because

Facts in brief about Lesotho

Capital: Maseru.
Official languages: English and Sesotho.
Official name: Kingdom of Lesotho.
Area: 30,355 km².
Population: *Estimated 1996 population*—2,025,000; density, 67 people per km²; distribution, 80 per cent rural, 20 per cent urban. *1986 census*—1,447,000; *Estimated 2001 population*—2,286,000.
Chief products: *Agriculture*—beans, cattle, goats, maize, mohair, peas, sheep, sorghum, wheat, wool.
Flag: The flag has diagonal stripes of white, blue, and green. A shield that is part of the country's coat of arms appears in the upper left. The flag was adopted in 1987. See **Flag** (picture: Flags of Africa).
Money: *Currency unit*—loti. One loti = 100 lisente.
National anthem: "Lesotho Fatse La Bo-Ntata Rona" ("Lesotho Our Fatherland").

most of the country lies more than 1,500 metres above sea level. Annual rainfall averages 70 centimetres and most of it falls between October and April. Temperatures in the western plains range from 32° C in summer to −7° C in winter. In the highlands, temperatures often fall below freezing in the winter.

Economy. The most important economic activity within Lesotho is rearing cattle, goats, and sheep. Farmers grow asparagus, beans, maize, peas, sorghum, and wheat. The best farming land lies in the western plains, where about two-thirds of the people live. Overcultivation and overgrazing have damaged Lesotho's soil. Lesotho manufactures clothing, textiles, and furniture and processes some agricultural products. The country has diamond deposits. However, diamond mining was discontinued in the early 1980's because of a worldwide slump in the price of diamonds.

Lesotho does not have enough jobs for its people. At any one time, about half of all the men are working in South Africa in mines, factories, farms, or households. Generally, they work on contracts that last from several months to two years. The money that these *migrant labourers* earn in South Africa is vital to Lesotho's economy. The migrant labour is the country's most important economic activity. The law provides that 60 per cent of each migrant worker's wages must be deposited in the government-owned Lesotho Bank. The worker's family may withdraw half of the deposited funds, but the other half must stay in the bank until the worker returns from South Africa. This system enables the government to invest some of the funds in development projects.

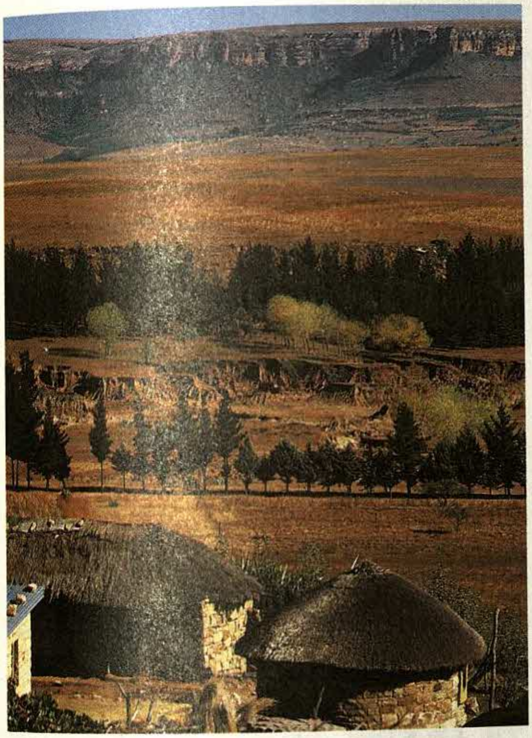
Most of the country's roads lie in the western plains. In the highland areas, the Basotho travel on hardy ponies and horses along winding trails.

History. Tribal wars swept over southern Africa in the late 1700's and early 1800's. Tribes were almost completely wiped out and their homes were destroyed. Some of the victims of this fighting fled into the highlands of what is now Lesotho. There they were given protection by an African chief named Moshoeshoe. He built a stronghold on a hill called *Thaba Bosiu* (Mountain of Night), about 24 kilometres from where Maseru now stands. By 1824, he had about 21,000 followers. He united them into the Basotho nation.

Later, British and Boer settlers tried unsuccessfully to defeat the Basotho (see **Boers**). From 1856 to 1868, the Basotho were at war with Boer settlers. In 1868, Moshoeshoe asked Britain for protection. Britain established the protectorate of Basutoland, and Moshoeshoe and his people became British subjects. Moshoeshoe died in 1870, and in 1871 the territory was placed under the rule of the British Cape Colony, which is now part of South Africa. The government of the British Cape Colony tried to disarm the Basotho, but the Basotho fought off the Cape's soldiers. In 1884, Basutoland was reestablished as a British protectorate. A British colonial administrator governed the protectorate. Whites were forbidden to acquire land in the protectorate.

The Constitution, drawn up in 1960 and revised in 1964, was a major step toward self-government. The first general election under this Constitution was held in 1965. The Basutoland National Party (BNP) won 31 of the then 60 seats in the National Assembly, and Chief Leabua Jonathan, the BNP leader, became prime minister. Paramount Chief Motlotlehi Moshoeshoe II, great-grandson of Moshoeshoe, became king. In 1966, the protectorate of Basutoland became the independent kingdom of Lesotho.

Lesotho's capital, Maseru, lies near the northwestern border of the country. The national coat of arms is displayed on a pole, *upper right corner,* on the main street of the city. Only about a fifth of Lesotho's people live in urban areas.



A small Lesotho village lies in a mountain valley east of the capital, Maseru. Most of the houses have mud or turf walls and thatched roofs.

During a general election in 1970, early vote returns showed that the BNP would not keep its parliamentary majority. Chief Jonathan then suspended the Constitution and elections. He continued to rule Lesotho as prime minister. In 1986, military leaders overthrew Chief Jonathan and took control of the government. Major General Justin Lekhanya became head of the military government. In 1990, the government deposed King Moshoeshoe II. It installed Moshoeshoe's son as King Letsie III. In 1991, rival military leaders forced Lekhanya to leave office. General Elias Ramaema became head of the government. In free general elections held in 1993, the Basotho Congress Party (BCP) won all 65 seats in the National Assembly. Ntsu Mokhehle, the BCP leader, became prime minister. The new government stripped all power from the king, allowing him to retain a ceremonial role only.

In an unconstitutional move in 1994, King Letsie III dissolved Lesotho's parliament and set up a provisional council to govern in its place. Chairman of the council, Hae Phoofolo, said their priorities were to amend the Constitution and reinstate Moshoeshoe as a full constitutional monarch.

Lespedeza is the name of a group of herbs and shrublike plants. It grows in Asia, Australia, and North America. Lespedeza shrubs are called *bush clover.* The leaves have smooth edges and three leaflets. The plant's small pea-shaped flowers grow in clusters. The fruit is a short pod with one seed.

Scientific classification. Lespedeza belongs to the pea family, Leguminosae (Fabaceae). Japan clover is *Lespedeza striata.*

Lessing, Doris (1919-), is an English writer noted mainly for her novels. Her fiction shows a deep concern for moral, political, and psychological attitudes and for the woman's role in modern society.

Lessing was born in Kermanshah, Persia (now Bakhtaran, Iran), and grew up in Southern Rhodesia (now Zimbabwe). She moved to England in 1949. *The Grass Is Singing* (1950), and her series of semiautobiographical novels, *The Children of Violence* (1952-1969), describe the difficulties of white women living in Africa and explore the problems of left-wing anticolonialists.

Lessing's most famous novel is the feminist political classic, *The Golden Notebook* (1962). This book describes the anxiety and confusion that a woman encounters in the modern world. In *The Summer Before the Dark* (1973), Lessing explored the subject of middle age. A series of philosophical science-fiction novels called *Canopus in Argos: Archives* began with *Shikasta* (1979).

Lessing has also written a horror novel, *The Fifth Child* (1988), as well as plays, poems, and short stories.

Lessing, Gotthold Ephraim (1729-1781), was a German playwright, critic, and philosopher. He is often considered the father of modern German literature. Lessing helped free German writing from neoclassical French influences. He turned the attention of German writers to English literature, especially the works of Shakespeare.

Lessing introduced English middle-class tragedy into Germany with his dramas *Miss Sara Sampson* (1755) and *Emilia Galotti* (1772). His play *Minna von Barnhelm* (1767) is one of the greatest German comedies. It influenced German popular theatre throughout the 1800's.

While serving as a theatre critic in Hamburg, Lessing wrote *The Hamburg Dramaturgy* (1767-1769). In this series of essays, Lessing discussed the drama of his time in relation to Aristotle's principles for tragedy. In his essay *Laokoön* (1766), Lessing discussed the relationship between poetry and painting. The essay is basic to classical German ideas of beauty.

Lespedeza plants have clusters of small red flowers.

Lessing was the first German playwright to put a sympathetic Jew on stage in *The Jews* (1749). His final drama, *Nathan the Wise* (1779), is his testament on religious tolerance. His *Education of the Human Race* (1780), an essay on the philosophy of history, also pleads for tolerance. Lessing was born in Saxony.

See also **German literature** (The Enlightenment).

Le Sueur, Pierre (1657?-1705?), a French explorer and trader, helped open up the upper Mississippi River Valley. He went to Canada in about 1679 and became an Indian trader. He persuaded the Sioux and Chippewa tribes to keep peace, and in 1695 took chiefs from these tribes to Montreal on a peace mission. During this period, he built Fort Le Sueur in what is now the American state of Minnesota. Later, he explored the Mississippi. He built Fort l'Huillier in 1700. Le Sueur was born in Artois, France.

Lethe was one of five rivers in the Underworld in Greek and Roman mythology. These rivers served as a boundary between the land of the living and the land of the dead. *Lethe* is a Greek word meaning *forgetfulness.* Drinking from Lethe caused the souls of the dead to forget what happened to them on earth. Those souls that were to be *reincarnated*—that is, reborn in new bodies—drank from Lethe to forget their former lives and their existence in the Underworld. Many poets have used Lethe as a symbol of forgetfulness or of a deathlike sleep. See also **Hades.**

Leto. See **Artemis; Niobe.**

Letter. See **Alphabet; Letter writing.**

Letter of credit is issued by a bank, permitting an individual, a business firm, or a designated party to draw up to a stated amount of money on that bank. It often is used by companies to finance the movement of goods between countries. It is also used by travellers.

A person or business firm may obtain a letter of credit by depositing funds with a bank. The bank issues the letter, which states the terms under which money can be withdrawn. The original or designated letter holder can obtain money by presenting the letter to another bank and making out a *draft* (order to pay). The letter may be addressed to one bank, or it may be a *circular* letter, which is good almost anywhere in the world. If the bank is in another country, the holder receives the money in the currency of that country. Money not withdrawn is refunded to the depositor.

Letter writing is a way of communicating a message in written words. People write letters for both business and personal reasons. Business letters are generally more formal than personal letters. Business letters include those used to apply for jobs, letters of complaint, sales letters and reminders. Personal letters include correspondence between family members or friends, invitations, and thank-you notes.

Studies show that people who write well are more likely to have successful careers. Skill in writing business and personal letters can make a difference in your life. For example, a well-written letter applying for a job may lead to a good position. A well-written personal letter can help build or keep a valuable friendship.

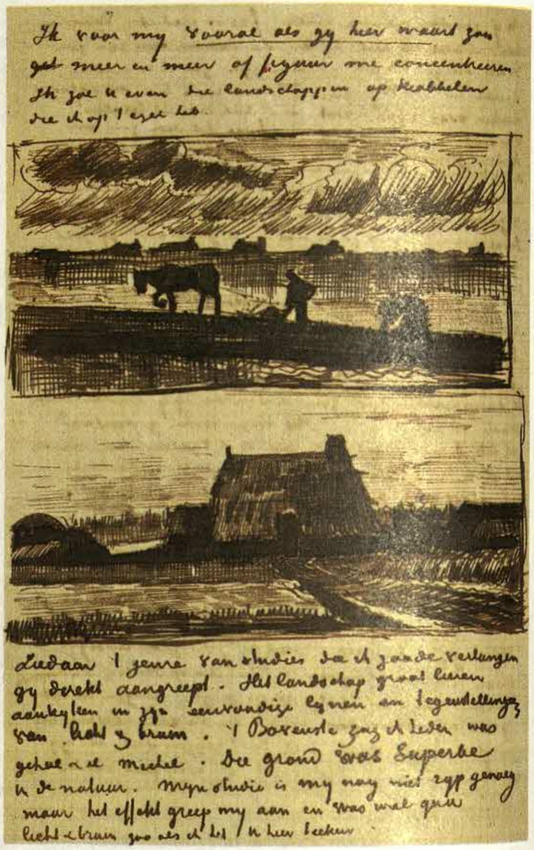
Characteristics of a good letter

A well-written letter should be clear, accurate, complete, concise, and courteous. The first step in preparing a good letter is deciding what to say. Make a brief list of the ideas you want to cover, and then plan the arrangement of these ideas. Next, decide how best to put your thoughts into words. It may help to write a rough copy of your letter simply to get the words on paper. Finally, go back and correct the sentence structure, grammar, and wording. Use simple, direct statements rather than long, involved sentences. Make each phrase easy for the reader to understand.

Be sure every statement in the letter is accurate. Business firms write letters every day just to clear up mistakes they made in previous letters. These follow-up letters would not be necessary if writers would take the time to give the facts correctly in their first letters.

Think carefully about your reader's familiarity with your topic. Have you included everything the reader needs to know? Forgetting even one necessary item can create confusion. If the letter discusses an appointment, be sure you mention the location, date, and time.

Say what you have to say and then stop. Too often, letters become cluttered with wordy phrases, stuffy expressions, and unnecessary details that dilute your message. Use plain, natural language and get to the point.



Ik voor my vooral als gy hier waart zou
[illegible] meer en meer op figuren me concentreeren
Ik zal u even de landschapjes op krabbelen
die ik op 't oog heb.

Zie daar 't genre van studies die ik zoo verlangen
gy direkt aangreept. Het landschap groot lucen
aankyken in zyn eenvoudige lynen en tegenstellingen
van licht & bruin. 't Bovenste zag ik laatst was
geheel in de mist. De grond was superbe
in de natuur. Myn studie is my nog niet zyn genoeg
maar het effekt greep my aan en was wel zeer
licht & bruin zoo als ik het u hier teeken.

Vincent van Gogh Foundation/National Museum Vincent van Gogh, Amsterdam

A letter from Vincent van Gogh to his brother Theo includes two sketches of rural scenes in the Netherlands about 1885. The famous painter wrote nearly 1,000 letters during his lifetime, often several a day. Many contained striking drawings.

The tone of the letter is as important as its language. In general, make the tone friendly and polite. Stress points that will interest the reader.

The parts of a letter

A letter has six standard parts. They are (1) the heading, (2) the inside address, (3) the salutation, (4) the body, (5) the complimentary close, and (6) the signature.

The heading in a business letter includes the writer's address and the date. It is located on the top of the page, and it usually has three lines. The first line gives the writer's street address, and the second gives the area, and postcode. The third tells the date the letter was written. Most of the heading may be omitted in a personal letter, but always include the date.

Business firms have printed or engraved letterheads that provide their name, address, and telephone number. Some also add the name or title of the writer, or the writer's department or section.

The inside address shows the name and address of the *recipient*—that is, the person or firm to whom the letter is written. In many business letters, the inside address can be written in three lines. The name of the recipient appears on the first line; the street address on the second; and the area, and postcode on the third. The inside address of a letter directed to an individual in an office should include the person's business title and the name of the firm. Most names and titles should be written out in full. However, some abbreviations of titles are commonly used, especially *Dr., Mr., Mrs.,* and *Ms.* See **Address, Forms of.**

The first line of the inside address should be placed at least two lines lower than the date. An inside address should appear in all business letters, but it is optional in personal letters.

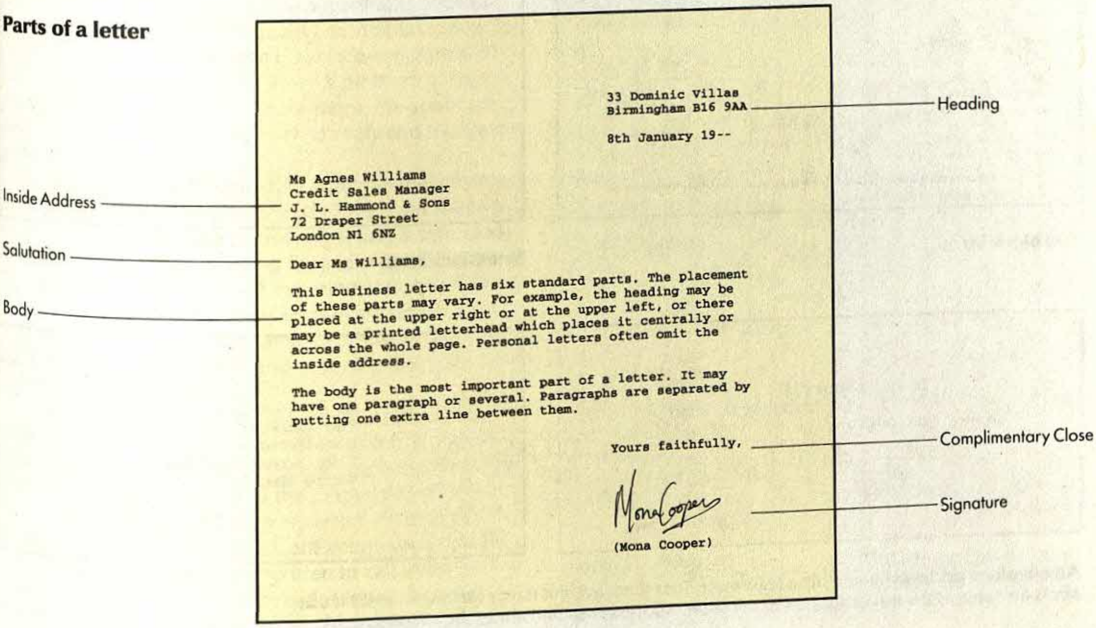
The salutation is also called the greeting. It should begin two lines below the last line of the inside address. In business letters, the most common salutation combines a title and the person's last name, such as *Dear Ms. Dobson* or *Dear Dr. Davis.* Use *Dear Sir or Madam* when the recipient's name is unknown or when writing to a company. Call friends by their first name or a nickname, such as *Dear David* or *Dear Cindy.* Use a comma after the salutation.

The body contains the writer's actual message. In a typewritten letter, the body should begin two lines below the salutation. All paragraphs within the body should be separated by a space of one extra line.

The complimentary close. Just as the salutation greets the reader at the beginning of a letter, the complimentary close says good-bye at the end. These two parts of the letter should be consistent in their degree of formality.

In a letter that opens with *Dear Mr. Caldwell,* the complimentary close could be *Yours sincerely.* In some countries, such as America, *Sincerely Yours,* or *Sincerely* is appropriate. If a letter opens with *Dear Sir or Madam,* the complimentary close could be *Yours faithfully. Sincerely yours* or *Very truly yours* would be appropriate in America and other English-speaking countries. For an informal closing, *Kind* or *Best regards* is appropriate. If the salutation is *Dear Bill,* proper closings include *Sincerely,* and *With warmest regards.* The complimentary close should end with a comma. The close should be placed two lines below the body of the letter.

The signature is the writer's name. It should be handwritten in ink below the complimentary close. In typewritten letters, the writer's name should be typed four or five lines below the complimentary close, with the handwritten signature placed between the closing and the typewritten signature. The writer may add his or her title in parentheses. The abbreviation *Ms.* has replaced *Miss* or *Mrs* in many countries. Many women prefer this title because it does not reveal their marital status. In some companies, the writer's business title or department is placed on the line beneath the typed signature. The company's name may also be included with the signature.



Parts of a letter

Heading
Inside Address
Salutation
Body
Complimentary Close
Signature

33 Dominic Villas
Birmingham B16 9AA

8th January 19--

Ms Agnes Williams
Credit Sales Manager
J. L. Hammond & Sons
72 Draper Street
London N1 6NZ

Dear Ms Williams,

This business letter has six standard parts. The placement of these parts may vary. For example, the heading may be placed at the upper right or at the upper left, or there may be a printed letterhead which places it centrally or across the whole page. Personal letters often omit the inside address.

The body is the most important part of a letter. It may have one paragraph or several. Paragraphs are separated by putting one extra line between them.

Yours faithfully,

Mona Cooper

(Mona Cooper)

The form

The form of a letter depends on the way the six parts of the letter are arranged on the page. Two forms frequently used are *full block* and *semiblock.* Each may be used for both business and personal letters.

The full block form is the easiest and quickest to type. All parts of a letter in the full block form begin at the left margin. New paragraphs are not indented. An extra line of space separates the paragraphs.

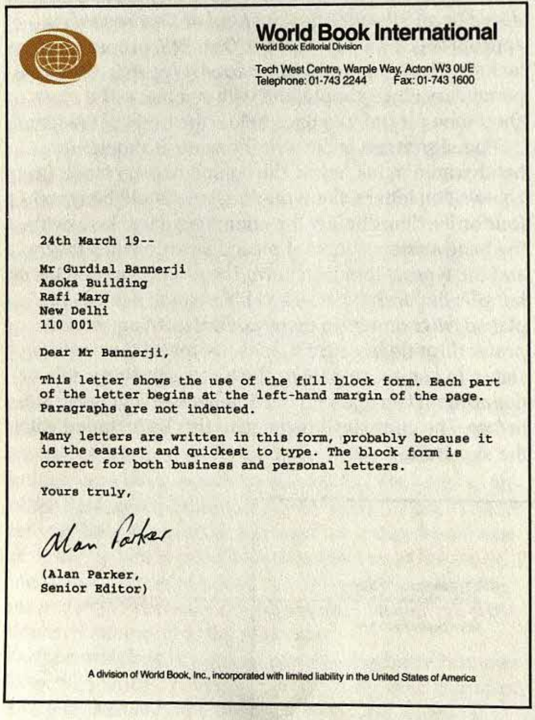
The semiblock form is less formal than the full block form. The heading is placed in the upper right-hand corner. Both the complimentary close and the typed signature line up vertically with the heading. All other parts of the letter begin at the left margin. New paragraphs are not indented. Like the full block form, the semiblock form separates the paragraphs with an extra line of space.

The envelope address usually is the same as the inside address of the letter. It is most commonly centred on the envelope. The address should be at least three lines long. Use the postcode on the last line alongside the area. In some countries, the writer's return address goes in the upper left-hand corner of the envelope. Always single-space addresses.

Business letters

There are many kinds of business letters. This section describes the following typical business letters: (1) letters of application, (2) letters of complaint, (3) sales letters, and (4) reminders. This section also offers suggestions that are helpful in most business letters.

Letters of application are written by people seeking a job. This type of letter normally consists of two parts, the *covering letter* and the *curriculum vitae* (CV) or *résumé.* A covering letter introduces the applicant to the employer. It accompanies a CV, which is a summary listing the applicant's education and work experience.



World Book International
World Book Editorial Division
Tech West Centre, Warple Way, Acton W3 0UE
Telephone: 01-743 2244 Fax: 01-743 1600

24th March 19--

Mr Gurdial Bannerji
Asoka Building
Rafi Marg
New Delhi
110 001

Dear Mr Bannerji,

This letter shows the use of the full block form. Each part of the letter begins at the left-hand margin of the page. Paragraphs are not indented.

Many letters are written in this form, probably because it is the easiest and quickest to type. The block form is correct for both business and personal letters.

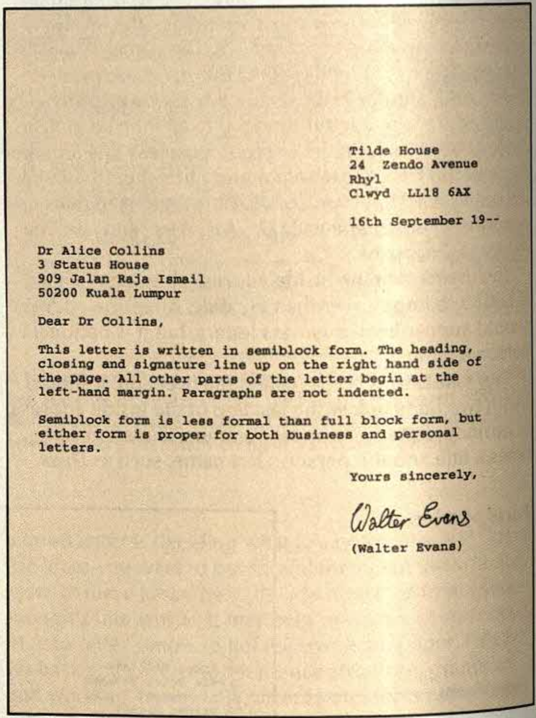
Yours truly,

Alan Parker

(Alan Parker,
Senior Editor)

A division of World Book, Inc., incorporated with limited liability in the United States of America

Full block form



Tilde House
24 Zendo Avenue
Rhyl
Clwyd LL18 6AX

16th September 19--

Dr Alice Collins
3 Status House
909 Jalan Raja Ismail
50200 Kuala Lumpur

Dear Dr Collins,

This letter is written in semiblock form. The heading, closing and signature line up on the right hand side of the page. All other parts of the letter begin at the left-hand margin. Paragraphs are not indented.

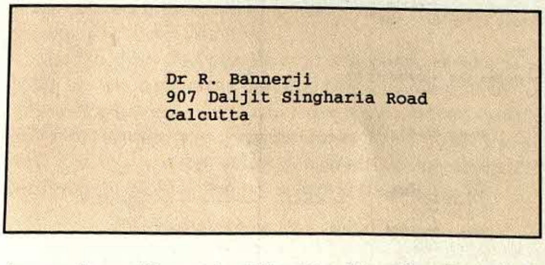
Semiblock form is less formal than full block form, but either form is proper for both business and personal letters.

Yours sincerely,

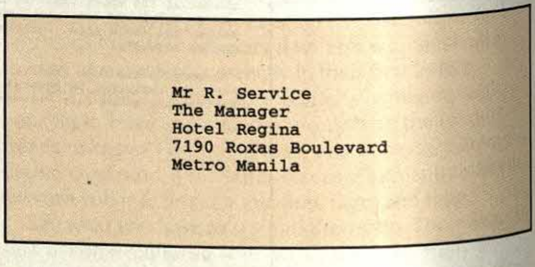
Walter Evans

(Walter Evans)

Semiblock form

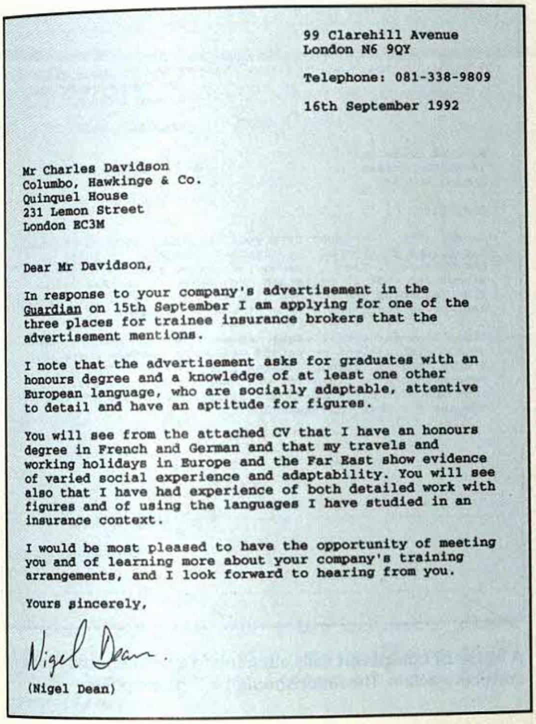


Dr R. Bannerji
907 Daljit Singharia Road
Calcutta



Mr R. Service
The Manager
Hotel Regina
7190 Roxas Boulevard
Metro Manila

An envelope address should be at least three lines long, *left,* but it may be longer, *right.* It usually is the same as the inside address of the letter. Addresses should always be single-spaced.



99 Clarehill Avenue
London N6 9QY

Telephone: 081-338-9809

16th September 1992

Mr Charles Davidson
Columbo, Hawkinge & Co.
Quinquel House
231 Lemon Street
London EC3M

Dear Mr Davidson,

In response to your company's advertisement in the Guardian on 15th September I am applying for one of the three places for trainee insurance brokers that the advertisement mentions.

I note that the advertisement asks for graduates with an honours degree and a knowledge of at least one other European language, who are socially adaptable, attentive to detail and have an aptitude for figures.

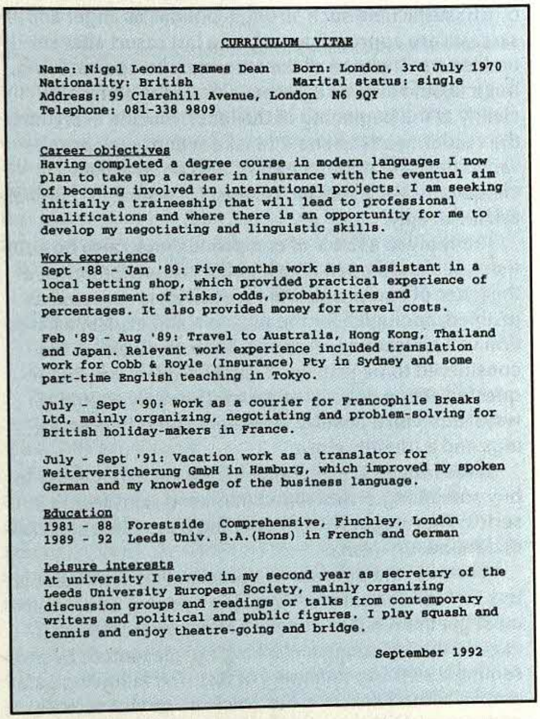
You will see from the attached CV that I have an honours degree in French and German and that my travels and working holidays in Europe and the Far East show evidence of varied social experience and adaptability. You will see also that I have had experience of both detailed work with figures and of using the languages I have studied in an insurance context.

I would be most pleased to have the opportunity of meeting you and of learning more about your company's training arrangements, and I look forward to hearing from you.

Yours sincerely,

Nigel Dean.

(Nigel Dean)



CURRICULUM VITAE

Name: Nigel Leonard Eames Dean   Born: London, 3rd July 1970
Nationality: British   Marital status: single
Address: 99 Clarehill Avenue, London N6 9QY
Telephone: 081-338 9809

Career objectives
Having completed a degree course in modern languages I now plan to take up a career in insurance with the eventual aim of becoming involved in international projects. I am seeking initially a traineeship that will lead to professional qualifications and where there is an opportunity for me to develop my negotiating and linguistic skills.

Work experience
Sept '88 - Jan '89: Five months work as an assistant in a local betting shop, which provided practical experience of the assessment of risks, odds, probabilities and percentages. It also provided money for travel costs.

Feb '89 - Aug '89: Travel to Australia, Hong Kong, Thailand and Japan. Relevant work experience included translation work for Cobb & Royle (Insurance) Pty in Sydney and some part-time English teaching in Tokyo.

July - Sept '90: Work as a courier for Francophile Breaks Ltd, mainly organizing, negotiating and problem-solving for British holiday-makers in France.

July - Sept '91: Vacation work as a translator for Weiterversicherung GmbH in Hamburg, which improved my spoken German and my knowledge of the business language.

Education
1981 - 88 Forestside Comprehensive, Finchley, London
1989 - 92 Leeds Univ. B.A.(Hons) in French and German

Leisure interests
At university I served in my second year as secretary of the Leeds University European Society, mainly organizing discussion groups and readings or talks from contemporary writers and political and public figures. I play squash and tennis and enjoy theatre-going and bridge.

September 1992

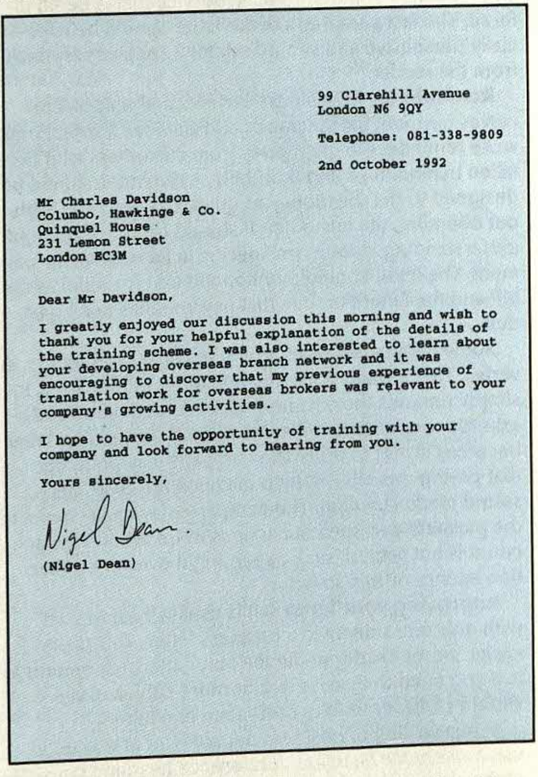
A covering letter and a CV make up a typical job application. The covering letter, *left,* introduces the applicant to the employer. The CV, *right,* describes the applicant's background.

The first paragraph of the covering letter tells what job the writer is applying for and how the applicant found out about the position. In the next one or two paragraphs, the writer should briefly emphasize the parts of his or her background that relate most closely to the job. In some countries, the law prohibits employers from asking applicants various questions such as their sex, race, religion, nationality, or marital status. The inclusion of such information is therefore optional. A covering letter should be no more than three or four paragraphs long. In the final paragraph, the applicant should politely ask the employer to reply and to arrange a job interview.

A letter of application can also combine the information that is in a covering letter and CV. It is usually two or three pages long. Like a covering letter, it should say what job the writer is applying for and point out parts of the applicant's education and experience that best fit the requirements of the job. Most employers prefer a CV with a covering letter rather than a combined letter of application because the CV and covering letter are more concise and easier to read.

In some countries, applicants are expected to send a *follow-up letter* after a job interview, which is a short letter thanking the employer for the interview. This letter should be written and sent to the employer within two days of the interview. A follow-up letter ensures that the employer is aware of the applicant's continued interest.

Letters of complaint are written to call attention to a problem and to persuade the reader to take corrective action. Although it is proper to express disappointment



99 Clarehill Avenue
London N6 9QY

Telephone: 081-338-9809

2nd October 1992

Mr Charles Davidson
Columbo, Hawkinge & Co.
Quinquel House
231 Lemon Street
London EC3M

Dear Mr Davidson,

I greatly enjoyed our discussion this morning and wish to thank you for your helpful explanation of the details of the training scheme. I was also interested to learn about your developing overseas branch network and it was encouraging to discover that my previous experience of translation work for overseas brokers was relevant to your company's growing activities.

I hope to have the opportunity of training with your company and look forward to hearing from you.

Yours sincerely,

Nigel Dean.

(Nigel Dean)

A follow-up letter should be sent within two days after a job interview. This short letter thanks the employer for the interview and expresses continued interest in the job.

or dissatisfaction, such strong emotions as anger and sarcasm are appropriate only as a last resort after several letters. The tone of the letter may be cool and firm, but it should also be courteous. State the complaint clearly at the beginning of the letter. Include everything the reader needs to know to take action, such as relevant dates, and photocopies of bills or cancelled cheques. Make a specific request for action, and politely ask for a reply.

The reply to a letter of complaint should also be courteous. It should open with a polite acknowledgment of the letter of complaint. If the complaint is accepted as justified, apologize for the problem and explain what action will be taken to correct it. If the complaint is not considered to be justified, tactfully explain why the requested action will not be taken. The reply should always end with a positive statement about future dealings and a friendly close.

Sales letters are intended to convince the reader to buy something. Firms sometimes send sales letters in series. They begin with an *opening* letter, then send several follow-up letters.

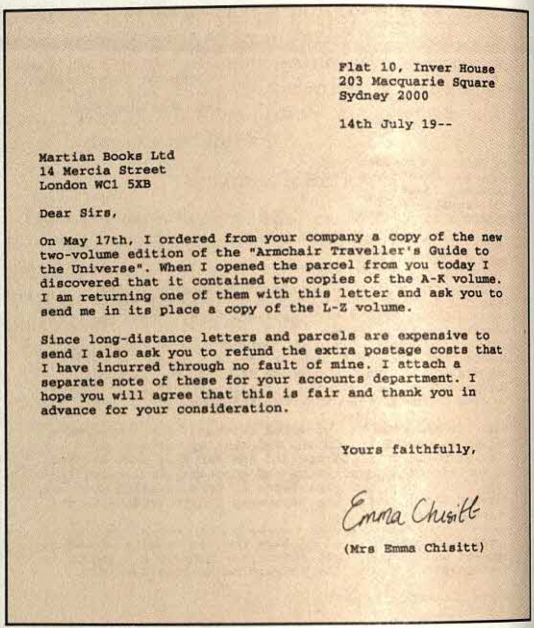
Whatever the purpose of the series, all good sales letters include certain elements. The opening paragraph must get the reader's attention and arouse interest. It may do this by asking a challenging question or by presenting a startling statement of fact. The following paragraphs should describe the article or service for sale, and how it would benefit the reader. The letter also should give the reader information about the quality and reliability of the product or service that is being offered. The last paragraph of the letter should be especially persuasive and should ask for a specific response from the reader.

Reminders. No business can succeed unless it receives payment for the goods and services it sells. Firms write reminders to get money from customers who have fallen behind in paying their bills. A reminder should be designed to get the money as quickly as possible, without offending the customer. It should be courteous and understanding in tone, yet specific in its request for payment. The letter should mention the exact amount of the bill and the length of time that payment has been past due.

Some companies send reminders, like sales letters, in series. They usually make the first letter mild in tone. It simply reminds the customer of the account due and asks for cooperation in paying it. Each succeeding letter becomes firmer in tone. The company may point out that paying this bill will help maintain the customer's sound credit standing. The company may finally demand the payment and spell out actions to be taken if the account is not settled, such as turning it over to a collection agency or to a solicitor.

Improving your letters. It is usually best to deal with only one subject in a business letter. This makes it easier for the reader to file the letter after responding to it. If you need to discuss two or more subjects, you should consider writing more than one letter.

When writing to business people, you may want to use a *reference headline.* A reference headline consists of the abbreviation *Re* and a short phrase describing the topic of the letter. Normally, it is placed at the beginning of the letter just beneath the inside address and after the salutation. By opening with such words as "Re: a design flaw in your new product," you are helping the reader understand your topic at first glance.



Flat 10, Inver House
203 Macquarie Square
Sydney 2000

14th July 19--

Martian Books Ltd
14 Mercia Street
London WC1 5XB

Dear Sirs,

On May 17th, I ordered from your company a copy of the new two-volume edition of the "Armchair Traveller's Guide to the Universe". When I opened the parcel from you today I discovered that it contained two copies of the A-K volume. I am returning one of them with this letter and ask you to send me in its place a copy of the L-Z volume.

Since long-distance letters and parcels are expensive to send I also ask you to refund the extra postage costs that I have incurred through no fault of mine. I attach a separate note of these for your accounts department. I hope you will agree that this is fair and thank you in advance for your consideration.

Yours faithfully,

Emma Chisitt

(Mrs Emma Chisitt)

A letter of complaint calls attention to a problem and requests corrective action. The letter should be firm but polite.

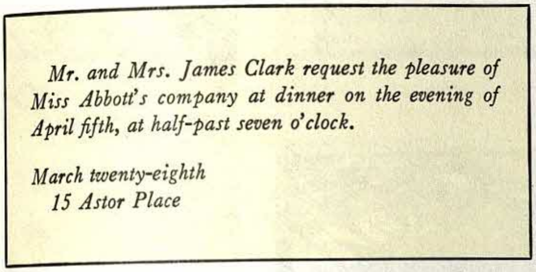
Consider putting topic labels, called *headlines,* on different sections or paragraphs of a letter to help clarify for the reader the points you wish to make. For example, copies of your letter may be going to two or more readers who have different levels of familiarity with your subject. In this case, you may want to put a section labelled "Background" towards the end of your letter. People who need this extra information can skim to the back, while those more familiar with the subject will find important facts such as "Results of a Survey" in a section at the start of the letter.

Personal letters

People generally use a more casual tone and style in personal letters than in business letters. As a result, there are fewer rules governing the form of personal letters than there are for business letters. However, some rules should be followed, especially in sending or receiving invitations. This section describes some of the guidelines for writing both formal and informal invitations, as well as thank-you notes and general personal correspondence.

Formal invitations are written in the third person. For example, a wedding invitation might begin, "Mr. and Mrs. Howard Jones request your presence at the marriage of their daughter, ..." Most formal invitations are either engraved or handwritten. Some business invitations are typed on executive letterheads.

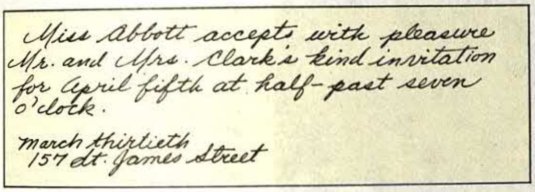
The invitation should begin with the name of the person or group extending the invitation. A description of the event should follow. Identify what the event is—such as a dinner, wedding, or party—and its date, time, and location. The heading of a formal invitation should be



Mr. and Mrs. James Clark request the pleasure of
Miss Abbott's company at dinner on the evening of
April fifth, at half-past seven o'clock.

March twenty-eighth
15 Astor Place

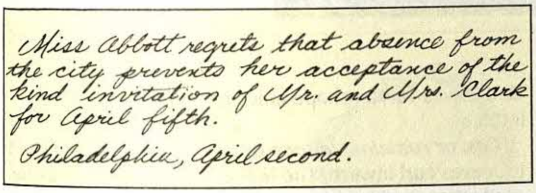
Formal invitation



Miss Abbott accepts with pleasure
Mr. and Mrs. Clark's kind invitation
for April fifth at half-past seven
o'clock.

March thirtieth
157 St. James Street

Acceptance



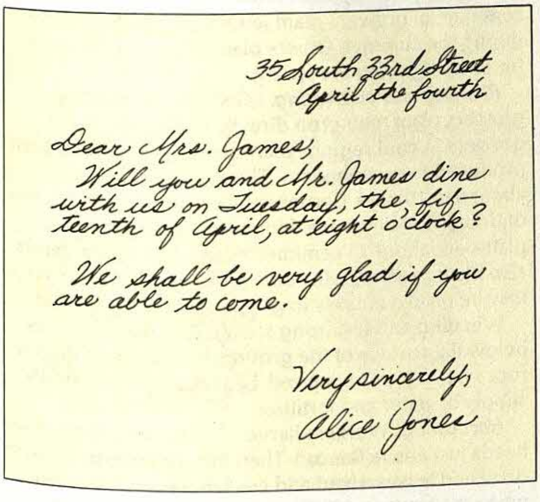
Miss Abbott regrets that absence from
the city prevents her acceptance of the
kind invitation of Mr. and Mrs. Clark
for April fifth.

Philadelphia, April second.

Declining

placed below the body of the invitation. The date should appear on the first line and the address should appear on the second line. The date should be spelled out. No signature is used in a formal invitation.

The letters *R. S.V.P.* may appear on the invitation. The letters are an abbreviation for the French phrase *Répondez, s'il vous plaît,* which means *Please reply.* An invitation may also say *Please reply* or *The favour of a reply is requested* instead of R. S.V.P. Any request for a reply should appear in the lower left-hand corner of an invitation.



35 South 33rd Street
April the fourth

Dear Mrs. James,
Will you and Mr. James dine
with us on Tuesday, the fifteenth of April, at eight o'clock?

We shall be very glad if you
are able to come.

Very sincerely,
Alice Jones

Informal invitation

Informal invitations are usually handwritten and friendlier in tone than formal invitations. The heading of an informal invitation remains at the top, with the date, unabbreviated, first and the writer's address next. A salutation comes next, ending with a comma. The body of an informal invitation contains the same kind of information that appears on a formal invitation. Some writers list the location, date, and time above each other. For example:

Location: 23 Dumas Avenue
London, W114EQ
Date: June 29, 19--
Time: 6:00 p.m. to 10:00 p.m.
Telephone: (081) 934-6089

The informal invitation concludes with a complimentary close and signature. An R.S.V.P. may appear in the lower left-hand corner.

Thank-you notes are simply brief letters of thanks for a gift, a dinner, or some other kind of hospitality. Writing a thank-you note shows gratitude and good manners. Make the note sound as if you were talking to your host or hostess in person. Thank-you notes are usually handwritten on a card or personal stationery.

Other personal letters include pen friend letters and correspondence between family members or friends. These letters follow no particular rules. Their purpose is to share news and thoughts with others.

Young people can make friends with others their age in another part of the country, or abroad, through pen friend letters. Many organizations and some magazines exist to provide names and addresses of people seeking pen friends. These people exchange letters, become friends, and eventually may meet in person.

Related articles in ***World Book*** include:

Address, Forms of
Etiquette
Grammar
Handwriting
Punctuation
Spelling

Outline

I. Characteristics of a good letter
II. The parts of a letter
- A. The heading
- B. The inside address
- C. The salutation
- D. The body
- E. The complimentary close
- F. The signature

III. The form
- A. The full block form
- B. The semiblock form
- C. The envelope address

IV. Business letters
- A. Letters of application
- B. Letters of complaint
- C. Sales letters
- D. Reminders
- E. Improving your letters

V. Personal letters
- A. Formal invitations
- B. Informal invitations
- C. Thank-you notes
- D. Other personal letters

Questions

What are the characteristics of a good letter?
How should a salutation be punctuated?
What are the six parts of a letter?
Where is the heading of a letter placed?
What does *R. S.V.P.* mean?
When are the following complimentary closes proper: (1) Yours sincerely? (2) Yours faithfully? (3) Sincerely yours?
How should the inside address of a business letter be arranged?
Why do people write letters of complaint?
What purposes do sales letters serve?
How should writers organize a cover letter?

Lettuce harvesting, *left,* begins after the heads become firm. Workers cut the heads, *above,* and pack them in boxes. A truck takes the boxes to a cooling tunnel. There, the heads are cooled before being shipped to market in precooled vehicles.

Letters of the alphabet. See Alphabet; and the separate articles on each letter.

Letters patent are *patent* (open) letters by which the government grants monopoly rights to inventors. The sovereign may also use letters patent to make grants of nobility. Letters patent are usually written on *vellum* (fine parchment) and are marked with the seal of the authority granting the patent.

An inventor is entitled to apply for letters patent for an invention. The inventor must complete a *specification* (detailed description) of the invention and pay a fee to have it filed at the Patent Office. If the patent officials accept the claim, the inventor pays an additional fee and receives a patent stamped with the royal seal.

Letts. See Latvia (The people).

Lettuce is a popular vegetable used chiefly in salads. People usually eat it fresh and uncooked. Lettuce forms a part of many weight-control diets because it contains few calories and provides calcium, iron, and vitamin A. Most kinds of lettuce have large, green leaves and grow close to the ground on extremely short stems. Lettuce ranks as an important farm crop in many areas of the world, and home gardeners grow several varieties of the plant. Lettuce farming probably began in Persia as early as 550 B.C.

Kinds of lettuce. There are three main kinds of lettuce: (1) *head;* (2) *leaf;* and (3) *cos,* or *romaine.*

Head lettuce has leaves that curl around the centre of the plant, forming a ball-shaped head. *Crisp head lettuce,* or *iceberg lettuce,* has a tight head and brittle, juicy leaves. Some people find that this type of lettuce has less flavour than the other types, and prize it more for its crispness than for its taste.

Leaf lettuce forms dense, leafy clumps instead of heads. Gardeners grow more of it than of any other kind. Most leaf lettuce has light green leaves, but a few red varieties have been developed for their taste and for the attractive colour they give to salads. The waxy, crinkled leaves vary in shape among various types of leaf lettuce.

Cos, or romaine, lettuce grows long and upright and its leaves curl inward. The leaves are tender and can be easily damaged in shipment. For this reason, cos is the least widely grown kind of lettuce, even though it is the most nutritious.

Other kinds of lettuce include *celtuce* and *wild lettuce.* Celtuce looks and tastes like a combination of celery and lettuce. Wild lettuce, from which all present-day varieties of the lettuce plant were developed, grows in mild climates throughout the world.

Growing lettuce. Most kinds of commercial lettuce grow well in temperatures between 21° and 24° C. Some varieties that were developed for gardeners thrive at just below 27° C. The planting season depends on local climate and the variety of lettuce to be grown. Some commercial growers plant lettuce in spring for harvest during the summer. Others plant in autumn or winter for harvest during the spring.

Planting and cultivating. Most commercial lettuce growers plant their crop directly in the field. Some growers in cool regions plant seedlings that have been produced in greenhouses. The seeds germinate in about 6 to 10 days. Gardeners then transplant them out of doors. Seedlings are thinned out until the remaining plants are about 25 centimetres apart. Many gardeners also plant seedlings. In some areas, winter lettuce crops may be grown entirely in greenhouses.

Weeding and fertilizing should take place at or just below the surface of the ground, or the plant's shallow root system may be injured. Lettuce requires a steady supply of water and fertilizer.

Harvesting. Workers harvest lettuce by cutting off the heads just above the soil. Then they remove any dead or damaged leaves. Head and cos lettuce are harvested when the leaves are firmest, about 70 to 90 days after seeding, depending on the variety. Leaf lettuce can be harvested whenever the leaves reach the desired size. Some gardeners pick individual outer leaves daily from the plants, allowing the remaining head to continue to grow. The larger, darker, outer leaves contain more nutrients than the paler inner leaves.

Packing and shipping. Lettuce spoils quickly and must be packed, cooled, and shipped immediately after being cut. On most lettuce farms, workers pack and vacuum cool the lettuce in the field. They pack the lettuce in cardboard cartons and put the cartons into a special refrigerated truck. In this truck, the temperature of the lettuce drops to just above freezing. On some farms, the lettuce is packed between layers of crushed ice in wooden crates and loaded onto refrigerated trucks or railway wagons for shipment to market.

Diseases and insect pests. The chief diseases of lettuce include *bottom rot, downy mildew,* and *lettuce drop.* Crop rotation and chemical treatment of the soil help prevent these diseases. Another disease, *tipburn,* may be caused by too much heat or humidity. Scientists have developed types of lettuce that resist tipburn. These types include Minetto and Fulton. Such insect pests as aphids, cabbage loopers, and cutworms destroy lettuce leaves and stems, but most of these pests can be controlled with insecticides.

Kinds of lettuce

Crisp lettuce is the basic ingredient of many salads. The various kinds of lettuce differ in shape, taste, and texture. Several of the most popular kinds are pictured below.

Butterhead is a type of cabbage lettuce that forms loose, partly folded heads.

Iceberg is a type of cabbage lettuce with crisp, wrinkled leaves.

Cos lettuce has upright, oblong leaves. They are crisp and sweet tasting.

Leaf lettuce does not form a true heart, but a loose bunch of leaves.

Bibb lettuce has dark green leaves that grow in small, loose clusters.

Celtuce lettuce combines the flavour of celery and lettuce.

Scientific classification. Lettuce belongs to the composite family, Compositae (Asteraceae). It is *Lactuca sativa.* Head lettuce is *L. sativa,* variety *capitata.* Leaf lettuce is variety *crispa,* and cos lettuce is variety *longifolia.*

Leu is a standard coin of Romania. The plural is *lei.* The coin is made of nickel-clad steel. It was formerly a silver coin. The leu equals 100 bani.

Leucocyte. See **Blood** (White blood cells).

Leucocytosis is an increase in the number of *leucocytes* (white blood cells). This condition normally occurs during digestion and in pregnancy. It may also occur because of inflammation or fevers.

Leukaemia is a kind of cancer in which abnormal white blood cells grow in an uncontrolled manner. These abnormal cells interfere with the production of normal white blood cells, which fight infection. Leukaemia is a disease of the bone marrow and other blood-forming organs. Consequently, leukaemia also affects the production of red blood cells, which carry oxygen from the lungs throughout the body, and *platelets,* blood cells that help stop bleeding. Signs of leukaemia include repeated infection, *anaemia* (a lack of functioning red blood cells), and frequent bleeding.

The cause of most human leukaemia is unknown. Researchers have discovered a leukaemia virus in cats, and they have identified a virus that appears to cause a rare type of leukaemia in human beings. Other possible causes include exposure to radiation and harmful chemicals.

Doctors classify leukaemia according to the type of white blood cell affected. Two of the main blood cell types affected by leukaemia are *myeloid* and *lymphoid.* Myeloid cells fight bacterial infections. Lymphoid (or lymphocytic) cells detect and respond to the presence of foreign substances in the body. All kinds of leukaemia can be either *acute* or *chronic.*

Acute leukaemias often develop suddenly. Abnormal, immature white blood cells multiply rapidly, and the number of normal cells decreases sharply.

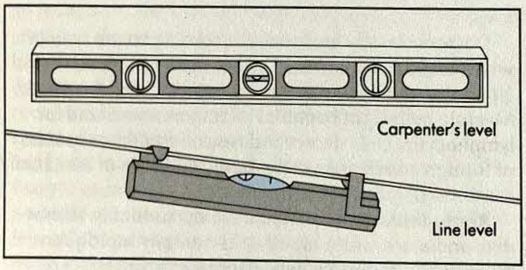
Acute myeloid leukaemia most often occurs among adults. The treatment for this leukaemia is *chemotherapy,* the use of chemicals that are more toxic to cancer cells than to normal cells. Seventy per cent of patients enter *remission.* During remission, the blood cells and the bone marrow temporarily return to normal. Researchers are trying to develop methods of prolonging remission in acute myeloid leukaemia patients.

Acute lymphocytic leukaemia is the most common leukaemia in children. The treatment may involve chemotherapy, radiation, or bone marrow transplant. Fifty per cent of these patients are cured. The treatment of acute leukaemias is intensive. The use of powerful antibiotics and of blood transfusions has increased the chances of surviving the therapy.

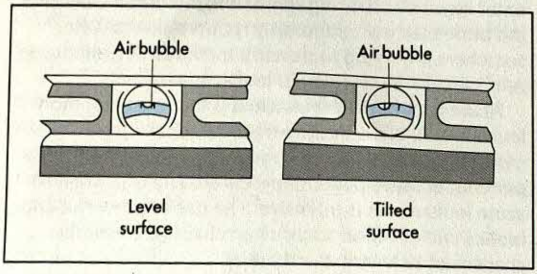
Chronic leukaemias develop more slowly than acute leukaemias. In chronic leukaemias, the abnormal white blood cells appear mature, and they resemble normal white blood cells. In the early stages of the disease, these abnormal cells even function normally to some extent. Chronic lymphocytic leukaemia is the most common leukaemia among adults. The average age of people afflicted with this disease is the early 70's. The disease may take as long as 10 years to develop completely. Chronic myeloid leukaemia is a less common form of leukaemia that occurs primarily among adults. Doctors generally use drugs to treat chronic leukaemia.

Leutze, Emanuel Gottlieb (1816-1868), gained fame as a painter of American historical subjects. His best-known painting is *Washington Crossing the Delaware* (1851), which he painted in Germany, using the Rhine as a model for the Delaware. In 1860, Congress commissioned him to paint a mural for the Capitol, the seat of the American government in Washington, D.C., *Westward the Course of Empire Takes Its Way.* Leutze was born at Gmünd, Germany, and studied art in Philadelphia in the United States and Düsseldorf, Germany. In 1859, he settled in New York City.

Level is an instrument used by carpenters, plumbers, and other construction workers to determine if a surface is perfectly horizontal. Most levels consist of a small, arched glass tube set in a bar of wood or metal. The tube is marked at its centre, which is its highest point. It contains alcohol or another liquid and a bubble of air. When a level is placed lengthwise on a perfectly horizontal surface, the bubble rests at the centre of the tube. If the surface being checked is tilted, the bubble rises to the high end of the tube. Some levels have additional tubes that are set at right angles to the length of the tool. These tubes enable workers to tell if a surface is *plumb* (vertical).



Kinds of levels include the *carpenter's level,* which checks horizontal or vertical surfaces, and the *line level,* which is hung along a tight string for levelling long spans.



How a level works is shown above. If the surface is level, the air bubble comes to rest at the centre of the tube. If the surface is tilted, the bubble is off centre.

Levels generally derive their names from their use. For example, *mason's levels* are used by masons in building walls of brick or stone. These levels measure up to a metre long and are the longest levels. A *carpenter's level* is similar to a mason's level, but is commonly about 60 centimetres long. *Line levels,* sometimes called *string levels,* are hung along a tight line or string. Builders use them in laying foundations and in performing other work that involves levelling long spans. Line levels, which are about 8 centimetres long, are the shortest levels. An *engineer's level,* also called a *surveyor's level,* is attached to a telescope and mounted on a *tripod* (three-legged stand). It provides engineers and surveyors with a perfectly horizontal line of sight.

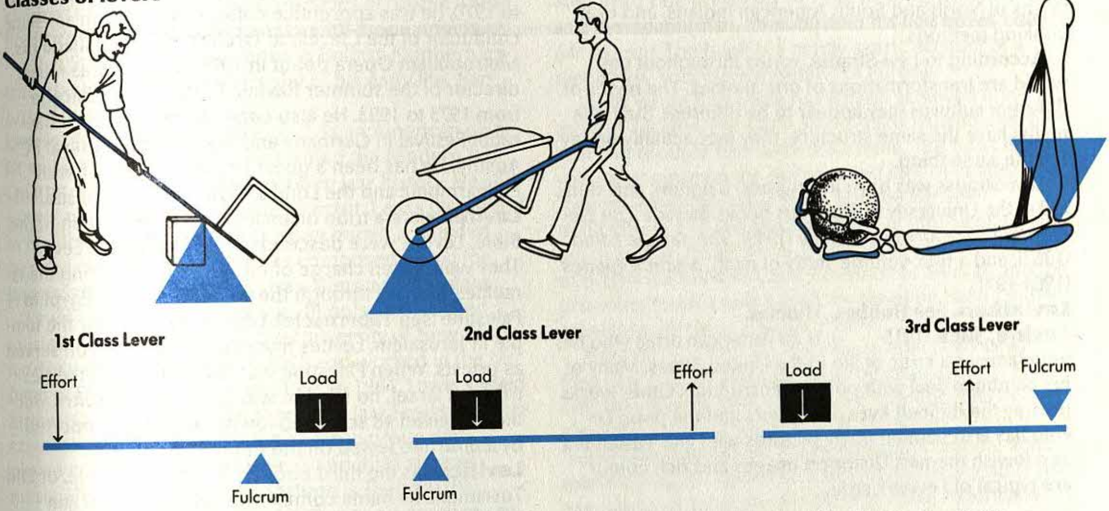
Levellers were political radicals in England during the mid-1600's who believed that all people deserved a voice in government. They declared that "The poorest that lives hath as true a right to give a vote as well as the richest and greatest." They voiced many democratic ideas that developed in England and America during the 1700's and 1800's.

The 1649 Levellers' pamphlet, *above,* was a protest against the actions of the English new parliament.

The Levellers had strong support among small farmers, artisans, and craftworkers, and they threatened the political power of the aristocratic landowners. Many soldiers who fought in the parliamentary army during the English Civil War in the 1640's were Levellers. But the Levellers found the new parliamentary government almost as aristocratic as the monarchy it had replaced. Leveller influence declined after 1649.

Lever is one of the six simple machines for performing work. It consists of a rod or bar that rests and turns on a support called a *fulcrum.* A force of effort is applied at one end of the rod to lift a load placed at the other end. The distance between the fulcrum and the load is the

Classes of levers



In a 1st class lever, the fulcrum is between the effort and the load.

In a 2nd class lever, the load is between the fulcrum and the effort.

In a 3rd class lever, the effort is between the fulcrum and the load.

load arm. The distance from the fulcrum to the applied force is the *effort arm.* A lever can help lift a weight with less effort. Prying something loose with a crowbar is using a lever. Some machines, such as a catapult, use a lever to hurl objects at high speed.

Classes of levers

First-class levers have the fulcrum placed between the load and the effort, as in the seesaw, crowbar, and balance scale. If the two arms of the lever are of equal length, the effort must be equal to the load. If the effort arm is longer than the load arm, as in the crowbar, the effort travels farther and is less than the load. A pair of scissors is a *double lever* of the first class.

Second-class levers have the load between the effort and the fulcrum. A wheelbarrow is a second-class lever. The axle of the wheel is the fulcrum, the handles take the effort, and the load is placed between them. The effort always travels farther and is less than the load. A nutcracker is a double lever of this class.

Third-class levers have the effort placed between the load and the fulcrum. The effort always travels a shorter distance and must be greater than the load. The forearm is a third-class lever. The hand holding the weight is lifted by the biceps muscle of the upper arm which is attached to the forearm near the elbow. The elbow joint is the fulcrum.

Compound levers combine two or more levers, usually to decrease the effort. By applying the principle of the compound lever, a person could use the weight of one hand to balance a load weighing a ton.

Law of equilibrium

A lever is in equilibrium when the effort and the load balance each other. The law of equilibrium is:

The effort multiplied by the length of the effort arm equals the load multiplied by the length of the load arm.

Let L be the load, E the effort, e the effort arm, and w the load arm. The law of equilibrium may be stated in a mathematical formula: L is to e as E is to w, or

$$E \times e = L \times w$$

To see how the formula works, imagine two children sitting on a seesaw. One child weighs 40 kilograms and sits 1.5 metres from the fulcrum. Where must the other child sit to balance the seesaw if the other child weighs 30 kilograms? Let the first child equal the load, L, and the second child the effort, E.

$$\begin{aligned} 30 \text{ kilograms} \times e &= 40 \text{ kilograms} \times 1.5 \text{ metres} \\ e &= \frac{60 \text{ kilogram-metres}}{30 \text{ kilograms}} \\ e &= 2 \text{ metres} \end{aligned}$$

Another example of a first-class lever is that of a person lifting a 300-kilogram stone with a 3-metre crowbar. The stone is 1 metre from the fulcrum. The person then pushes down on the crowbar 2 metres from the fulcrum. So, $E \times 2$ metres $= 300$ kilograms $\times 1$ metre; or $E = 150$ kilograms, the force needed to balance the stone.

This law of equilibrium is true for all classes of levers. A force multiplied by its lever arm is called a *moment of force,* or *torque* (see **Moment**). The law of levers may be stated simply by saying that the moment of the lifting force must equal the moment of the force due to the load.

The *mechanical advantage* of a lever tells how many kilograms of load can be moved by each kilogram of effort. It can be calculated by dividing the load by the effort or the length of the effort arm by the length of the load arm. In the crowbar example above, the mechanical advantage is 2, that is, 300 kilograms divided by 150 kilograms, or 2 metres divided by 1 metre.

See also **Archimedes; Torque; Wheel and axle.**

Lévi-Strauss, Claude (1908-), a French anthropologist, developed *structuralism* in the study of human culture. Structuralism is a method of analysis that examines the structure of relationships between things, rather than simply the things themselves.

Lévi-Strauss derived the structural approach from *structural linguistics,* a science that studies languages through the structure of their sounds and words. He used structuralism to study family relationships, the myths of North and South American Indians, and even cooking methods.

According to Lévi-Strauss, myths throughout the world are transformations of one another. The myths of different cultures may appear to be different. But if the myths have the same structure, they may actually be saying the same thing.

Lévi-Strauss was born in Brussels, Belgium, and studied at the University of Paris. His books include *The Elementary Structures of Kinship* (1949), *The Savage Mind* (1962), and a four-volume study of myth, *Mythologiques* (1964-1971).

Leviathan. See **Hobbes, Thomas.**

Levine, Jack (1915-), is an American artist who has won fame as a critic of life in the United States. Many of his paintings deal with political corruption. Other works portray the difficult lives of workers and the poor. Levine has also painted many pictures with Old Testament and Jewish themes. Distorted images and rich colour are typical of Levine's style.

Oil painting on canvas (1953); collection of the Whitney Museum of American Art, New York City

Jack Levine's *Gangster Funeral* shows the distorted forms and rich colour typical of the artist's style. Levine became known for his satirical treatment of various aspects of American life.

Levine was born in Boston. In 1935, he worked for the Federal Art Project, a government programme.

Levine, James (1943-), is an American conductor and pianist. He became principal conductor of the Metropolitan Opera in New York City in 1973 and the company's music director in 1976. He became artistic director in 1986.

James Levine

Levine was born in Cincinnati and began piano lessons at the age of 4. He made his debut as a soloist at the age of 10, performing with the Cincinnati Symphony Orchestra. From 1964 to 1970, he was apprentice conductor and then assistant conductor of the Cleveland Orchestra. Levine made his Metropolitan Opera debut in 1971. He served as music director of the summer Ravinia Festival near Chicago from 1973 to 1993. He also conducts at the annual Bayreuth Festival in Germany and the Salzburg Festival in Austria. He has been a guest conductor of the Berlin Philharmonic and the London Symphony Orchestra.

Levites were a tribe of ancient Israel. According to the Bible, Levites were descendants of Jacob's son Levi. They were given charge of the Tabernacle during the Israelites' journey through the wilderness from Egypt to Palestine (see **Tabernacle**). Later, they cared for the temple in Jerusalem. Levites from the family of Aaron served as priests. When Palestine was divided among the 12 tribes of Israel, no section was given to the Levites. But they received 48 scattered towns and were supported by a *tithe* (tax) levied on the other 11 tribes.

Leviticus is the third book of the Hebrew Bible, or Old Testament. Its name comes from its title in the Latin translation of the Bible, which calls it *Book of Levis.* The title refers to the tribe of Levi, from which the Hebrew priests were descended. The book is composed almost entirely of priestly regulations. However, many of these rules concern nonreligious life and thus show how all aspects of life were considered part of religious behaviour. See **Pentateuch.**

Leviticus has four main parts. The first, *Sacrificial Laws* (1-7), lists the different kinds of offerings the people made. The second, *The Consecration of Aaron* (8-10), describes the High Priest taking office. The third, *The Purity Laws* (11-16), deals with individual purity and national atonement. The fourth, *The Holiness Laws* (17-27), includes a special section called the Holiness Code (19-25). The code calls for people to obey God's law and to become a holy people in imitation of God, who is the supreme example of holiness.

Lewes (pop. 85,400) is a local government district in East Sussex, England. The town of Lewes, the district's administrative centre, also has the offices of East Sussex County Council. The district's other main towns are the port of Newhaven, from which cross-channel ferries operate, and the seaside resort of Seaford. The many attractive villages in Lewes include Barcombe, Newick, and Wivelsfield Green. Glyndebourne has a famous annual opera festival.

In 1264, Simon de Montfort routed the forces of Henry III at Lewes. The town of Lewes has the remains of a Norman castle. Industries in the district include the production of pens and electrical goods. Agriculture is important in much of the district.

See also **Sussex.**

Lewis. See **Western Isles.**

Lewis, C. S. (1898-1963), a British author, wrote more than 30 books. Most of his writings teach moral lessons. After years of experiencing religious doubt, he converted to Christianity in the 1930's. Lewis then became a leading defender of Christianity.

Lewis' most popular religious work, *The Screwtape Letters* (1942), is a witty satire in which an old devil advises a young devil. His other books on religion include *The Problem of Pain* (1940), *The Abolition of Man* (1943), and *Mere Christianity* (1952).

Between 1950 and 1956, Lewis wrote a series of seven children's books called *The Chronicles of Narnia.* These books combine myth and fantasy with moral principles.

Clive Staples Lewis was born in Belfast, Northern Ireland. He wrote an autobiography of his early life, *Surprised by Joy* (1955).

Lewis, John Aaron (1920-), is an American pianist and composer. In 1952, he formed the Modern Jazz Quartet, the most durable combo in jazz history. He still serves as its pianist and music director. Lewis pioneered in the development of *third stream music,* a blend of jazz and classical music. He has composed music for jazz ensembles, large orchestras, films, and the stage.

Lewis was born in La Grange, Illinois, and studied music and anthropology at the University of New Mexico. He went to New York in 1945 and worked in the big band of Dizzy Gillespie. From 1958 to 1964, Lewis served as musical director for the Monterey Jazz Festival. He occasionally led Orchestra U.S.A., a large group that played concerts of jazz, classical, and third stream music. His best-known composition is *Django* (1952).

Lewis, Meriwether (1774-1809), was an American explorer. With William Clark, he led the famous Lewis and Clark expedition, which explored the Louisiana Territory and the Pacific Northwest, a wilderness in the northwestern United States, from 1804 to 1806.

In 1801, Lewis, a captain in the United States Army, became private secretary to U.S. President Thomas Jefferson. Under Jefferson's direction, Lewis made plans to explore a route west to the Pacific coast of North America. Lewis invited Clark to join the expedition.

The expedition started up the Missouri River in May 1804 from a camp near St. Louis. By late autumn, the explorers had reached what is now North Dakota, and they spent the winter there. The following spring, they continued along the Missouri and, in late summer, crossed the Rocky Mountains. The explorers reached the Pacific coast in November 1805. The party spent the winter on the coast of what is now Oregon and returned along nearly the same route by which they had come, reaching St. Louis in September 1806.

Lewis served as the party's naturalist and, on the expedition, collected plant, animal, and mineral specimens. As a reward for his service, Jefferson named Lewis governor of the Louisiana Territory in 1807.

Lewis was born in Albemarle County, Virginia. He joined the U. S. Army in 1794.

See also **Clark, William; Lewis and Clark expedition; Sacagawea; Whiskey Rebellion.**

Lewis, Sinclair (1885-1951), gained international fame for his novels attacking the weaknesses he saw in American society. In 1930, Lewis became the first American author to win the Nobel Prize for literature.

Harry Sinclair Lewis was born on Feb. 7, 1885, in Sauk Centre, Minnesota. At the age of 21, he lived briefly at Helicon Hall, a socialist community in New Jersey founded by writer Upton Sinclair. Lewis graduated from Yale University in 1908. In 1914, while working as a newspaperman, he published his first novel, *Our Mr. Wrenn.* The book is a gently satiric account of a meek New York clerk travelling in Europe.

Sinclair Lewis

Lewis wrote four more novels and achieved only modest success. But *Main Street* (1920) caused a sensation and brought him immediate fame. The book is a withering satire on the dullness and lack of culture of a "typical" American small town, and the narrow-mindedness and self-satisfaction of its inhabitants. Written in minute detail, *Main Street* chronicles the fruitless efforts of the heroine Carol Kennicott to awaken and improve her town. Lewis based the novel on Sauk Centre, renaming the town "Gopher Prairie."

Babbitt (1922) focuses even more effectively Lewis' idea of a "typical" small city businessman, George F. Babbitt. The novel describes the futile attempt of its central character to break loose from the confining life of a "solid American citizen"—a middle-class, middle-aged estate agent, civic booster, and club joiner. Possibly no two works of literature did more to make Americans aware of the limitations of their national life and culture than did *Main Street* and *Babbitt.*

With a sharp, satiric eye, Lewis continued to examine other aspects of what he considered national inadequacy. *Arrowsmith* (1925) describes the frustrations of an idealistic young doctor in conflict with corruption, jealousy, meanness, and prejudice. The novel won the 1926 Pulitzer Prize, which Lewis declined, perhaps because he felt he should have received a prize sooner. *Elmer Gantry* (1927) satirizes religious hypocrisy and bigotry in the Midwest.

In 1928, Lewis married Dorothy Thompson (1894-1961), who was a famous foreign correspondent and newspaper columnist. Their marriage ended in divorce in 1942.

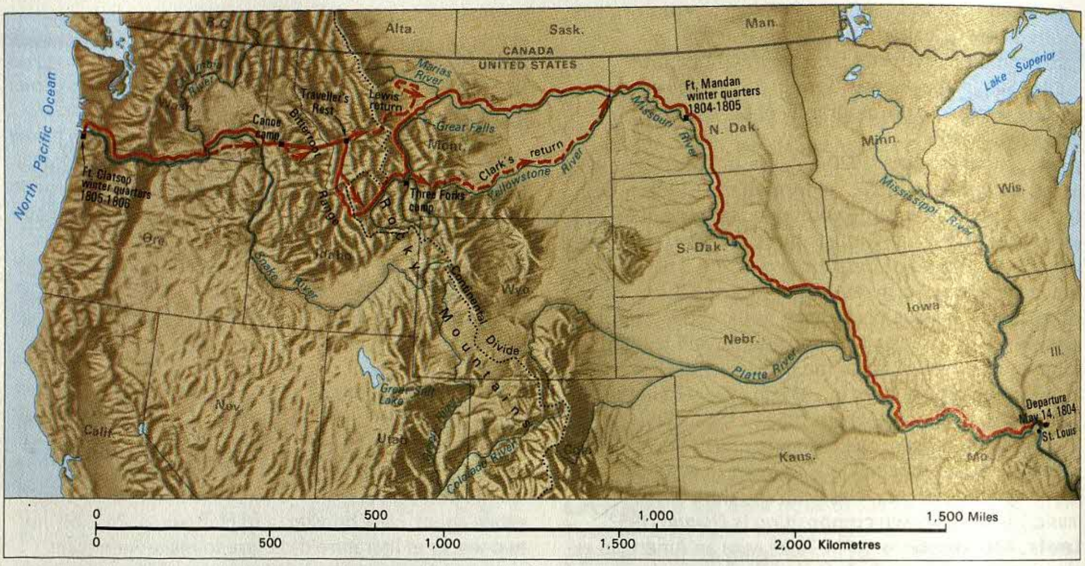
Dodsworth (1929) was perhaps the last of Lewis' best works. The novel contrasts American with European life while relating the marriage difficulties of a prosperous American businessman on a European tour.

Lewis' later novels were primarily shallow photographic realism. Critics now consider Lewis less a truly creative artist than an extraordinarily accomplished observer with a vivid descriptive style. Lewis died lonely and unhappy in Italy in 1951.

Lewis and Clark expedition was the first exploration by the United States government of the country's vast northwestern wilderness. The expedition, led by Meriwether Lewis and William Clark, began in 1804 and lasted more than two years.

Lewis and Clark started up the Missouri River from St. Louis and travelled almost 12,400 kilometres to the Pacific Coast. They returned with maps of the frontier and information about the region's natural resources and the Indian tribes who lived there. The success of the expedition enabled the United States to claim the Oregon region. This claim, in turn, helped make possible the great pioneer movement that settled the West during the 1800's. The expedition consisted of about 45 people. John Colter, who later became a famous American trapper, was a member of the expedition.

In December 1803, the men of the expedition built Camp Dubois across the Mississippi River from St.



The Lewis and Clark expedition left a camp near St. Louis, U.S.A., in 1804, journeyed up the Missouri River, and crossed the Rocky Mountains. The explorers reached the Pacific Coast in 1805. They returned to St. Louis in 1806 with valuable information about the new frontier.

Louis. They stayed at the camp during the winter. A large flat-bottomed boat called a *keelboat* was built for the trip. It measured about 18 metres long and could be rowed or sailed, or poled like a raft. Lewis and Clark stored many tons of supplies, including flour, meal, medicine, salt, and weapons. The men also acquired a large supply of coloured beads and other small gifts for the Indians they expected to meet.

Up the Missouri. On May 14, 1804, the expedition set out in the keelboat and two dugouts. As the men travelled up the Missouri River, Lewis went ashore occasionally and was amazed by the large number of animals he saw. He wrote in his journal: "I do not think I exaggerate when I estimate the number of buffalo which could be comprehended [seen] at one view to amount to 3,000."

In September, the explorers had their first encounter with Indians. Some of them went ashore to talk to a group of Sioux Indians and offer them gifts. However, the Indians demanded more gifts and would not allow Clark to return to the boat. The Sioux let him go when Clark's men showed they were ready to fight.

In October, the expedition reached a village of friendly Mandan Indians in what is now North Dakota. The explorers built Fort Mandan near the village and spent the winter there. During the winter, a French-Canadian trader named Toussaint Charbonneau and his wife, Sacagawea, a Shoshone Indian, joined the expedition.

West to the Rockies. The journey resumed on April 7, 1805. As the explorers travelled farther west, they saw many grizzly bears. The huge bears threatened the expedition continually. An attacking grizzly had to be shot several times before it died.

Crossing the mountains was the most difficult part of the journey. The explorers had to get off their horses and lead them along rocky, narrow mountain paths. Some of the horses lost their footing and fell to their death. As the expedition travelled farther into the Rockies, there were fewer and fewer animals to hunt for food. The explorers killed some of their horses and ate them.

The group crossed the Rockies in about a month. After reaching the Clearwater River in what is now Idaho, they built new canoes and paddled toward the Columbia River. The expedition reached the Columbia in October and travelled as fast as possible so they could reach the Pacific Coast before winter. They arrived at the coast in November 1805 and built Fort Clatsop near the mouth of the Columbia River. They spent the winter at the fort.

Results of the expedition. The most important result of the Lewis and Clark expedition was that it enabled the United States to claim the Oregon region. This claim, plus the purchase of the Louisiana Territory, played an important part in the settlement of the West.

See also **Clark, William; Lewis, Meriwether; Sacagawea; Colter, John.**

Lewisham (pop. 215,300) is a borough in Greater London, England. It includes the former boroughs of Deptford and Lewisham. The borough is situated in south London and is mainly residential. Blackheath, in the borough, is a pleasant open space surrounded by houses. Colfe's almshouses were built in the 1690's, and Boone's Chapel dates from the 1680's.

Lexcen, Ben (1936-1988), a self-taught Australian marine architect, designed the controversial and revolutionary winged keel for *Australia II.* In 1983, the yacht became the first non-American entry to win the America's Cup. Lexcen was born Bob Miller in Boggabri and was educated in Newcastle, New South Wales. He served his apprenticeship as a fitter and turner in the railways. But his interest in boats eventually led him into becoming a sailmaker and boatbuilder by the age of 25.

Lexington, Kentucky (pop. 204,165; met. area pop. 317,629), is one of the chief trading centres for tobacco in the United States. The Lexington area also is a leading market for race horses. Lexington ranks as Kentucky's second largest city. Only Louisville has more people.

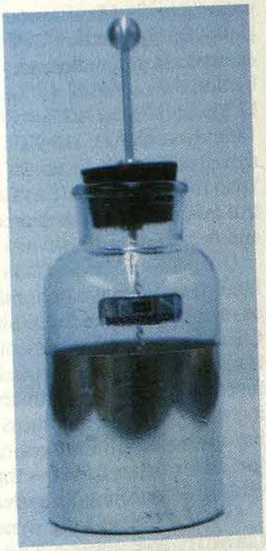
The grass and water of the area around Lexington are rich in minerals that give horses strong bones and muscles. Auction markets in the Lexington area handle hundreds of horses every year and sell millions of kilograms of tobacco.

Lexington, Battle of. See **American Revolution** (Lexington and Concord).

Leyden. See **Leiden.**

Leyden jar was one of the first devices used to store an electric charge. It was invented in Leiden (sometimes spelled Leyden), the Netherlands, in 1746. A Leyden jar is a glass jar sealed with a cork. Sheets of metal foil cover about half of the inside and outside of the jar. The foil conducts electricity, but the glass does not. A brass rod is inserted through the cork and brought in contact with the foil inside the jar.

When the brass rod is connected to a source of electricity, current travels through the rod and charges the inner foil. Current cannot pass through the glass, but the foil on the outside becomes charged by *induction* if it is properly grounded (see **Induction, Electric**). The outer foil has a charge opposite to the charge inside the jar. When the flow of current into the jar stops, a charge remains stored in the jar. If the inner and outer layers of foil are then connected by a conductor, their opposite charges will cause a spark that discharges the jar. See also **Capacitor.**



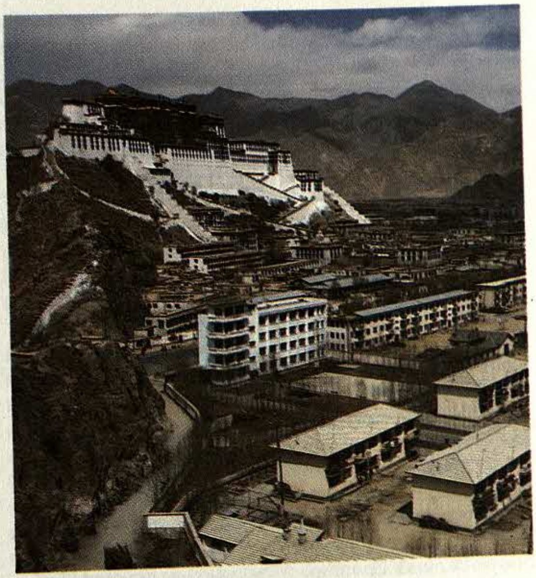
Leyden jar

Leyte. See **Philippines** (The main islands).

Lhasa (pop. 105,866) is the capital and holy city of Tibet. Tibetans consider the city's temples sacred. The Dalai Lama, a spiritual leader and exiled ruler of Tibet, lived in Lhasa until 1959. In that year, he went into exile in India with many of his followers after a failed revolt in Tibet against the Chinese Communists. Until 1904, Europeans were banned from Lhasa, and it is sometimes called *The Forbidden City.*

Lhasa lies 3,597 metres above sea level in the Himalaya Mountains of southeastern Tibet. It is the second highest capital in the world after La Paz, Bolivia, which is about 3,660 metres above sea level.

Lhasa is a closely packed city of stone and brick houses and shops. The city also has many monasteries and temples. Most of the houses have low, flat roofs and no chimneys. Oiled paper, instead of glass, is used in the windows. The 13-floor Potala Palace stands out above the city. Now a museum, the palace once served as a temple, the centre of Tibet's government, and the home of the Dalai Lama.

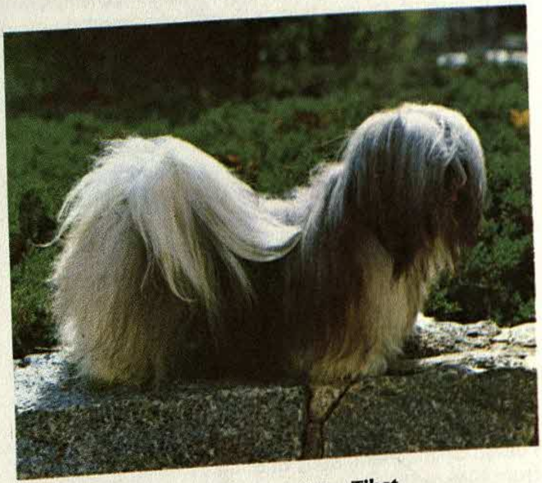


Lhasa's Potala Palace stands high above the city. Before Communist China took over Tibet in 1959, the Potala Palace was a temple and also the home of Tibet's spiritual leader, the Dalai Lama. It is now a museum.

See also **Tibet** (Cities; map).

Lhasa apso is a dog that came originally from Lhasa, the capital of Tibet. It was once known as a terrier, but is now classed as a nonsporting dog. The Lhasa apso has a long, heavy coat that looks like a mop. Its hair falls thickly over its face, covering its eyes and ears. It also has whiskers and a beard. The Lhasa apso has a long, low body, and carries its feathery tail curled tightly over its back.

In Lhasa, this dog was used as a watchdog, even though it is only about 25 centimetres high. A large dog guarded the door outside, while the little Lhasa apso stayed inside to warn of danger. See also **Shih Tzu.**



The Lhasa apso originally came from Tibet.

Li Bo (701-762) was one of China's greatest poets. There are several other spellings of his name, but the most common are *Li Po* and *Li Bai.* Li Bo's poetry is admired for its eloquence, wit, humour, and romantic descriptions of nature, especially of the moon. Li Bo also wrote poems praising the virtues of wine. He composed many poems at banquets and special occasions to entertain his friends and patrons. He believed his most important works were his poems on ethics and morality.

Li Bo was probably born in what is now Kyrgyzstan, west of China. His family originally came from China, and they returned to the country when Li Bo was 5 years old. From 725 until his death, Li Bo travelled throughout China, supporting himself by writing poems and documents for wealthy people.

See also **Chinese literature** (Poetry).

Li Hsien-nien. See Li Xiannian.

Li Peng (1928-) is one of China's top leaders. He became acting premier of China in November 1987 and was named premier in April 1988. The premier heads the operations of the government. Since 1985, Li has been a member of the *Politburo,* the chief policymaking body of China's Communist Party. He has devoted his career to the development of energy resources. His rise to power reflects China's increased interest in the development of technology in the 1980's.

In 1989, the Chinese military killed many people demonstrating for greater democracy in China. Li was one of the leaders who called for the use of force to put down the demonstration.

Li was born in Chengdu. His father was a revolutionary writer who was executed by China's Nationalist government in 1931. In 1939, Communist leader Zhou Enlai and his wife, Deng Yingchao, took Li under their care. From 1949—when the Communists gained control of China—until his death in 1976, Zhou served as premier of China. From 1948 to 1955, Li studied hydraulic engineering at Moscow Power Institute in the Soviet Union.

Li Po. See Li Bo.

Li Siguang (1889-1971) was a Chinese geologist. He made important contributions to the sciences of *palaeontology* (study of fossils), *glaciology* (study of glaciers), and *seismology* (study of earthquakes). Li Siguang founded the new discipline of geological mechanics, the branch of geology that deals with stresses and strains. His theories of *geomechanics* played a vital part in the discovery of several large oil fields in China. His main works included *Quaternary Glaciation in the Lushan Area, Central China* (1947), and *Introduction to Geomechanics* (1962).

Li Siguang was born in Huanggang County, Hubei (or Hupeh) province. He studied science in Japan and the United Kingdom. In 1920, he became a professor in the geology department of Beijing University. In 1927, he was appointed director of the Institute of Geology of *Academia Sinica,* then in Nanjing. After the Communists established the People's Republic of China in 1949, he became minister of geology.

Li Xiannian (1909 ? -1992), also spelled Li Hsien-nien, was one of the longest-serving first generation Chinese Communist Party leaders. He was China's minister of finance from 1954 to 1966. Li was a member of the Politburo—the ruling body of China's Communist Party—from 1956 to 1987. He was vice premier of the government from 1978 to 1983 and an economic adviser to the premier of China. He held the largely ceremonial posts of president from 1983 to 1988, and head of the Chinese People's Political Consultative Committee from 1988 to 1992.

Li, the son of poor peasants, was born in Hubei (or Hupeh) province. He received almost no education, and worked as a carpenter in his youth. In 1927, he joined a Communist-led peasant uprising. For the next 10 years, he led Communist guerrillas in central China against the Chinese Nationalist forces. Li commanded Communist troops during the war between China and Japan (1937-1945). After the Communists conquered China in 1949, he became a party and government administrator in the industrial city of Wuhan.

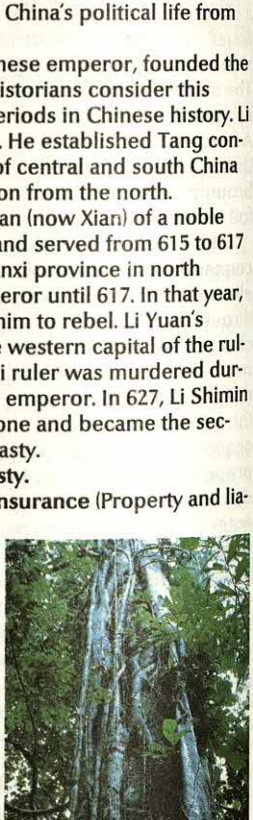
Li criticized Mao Zedong in 1958, yet remained sympathetic to the Maoist inheritance. He also criticized Deng Xiaoping in the 1980's. Throughout his career he exerted a strong influence on China's political life from behind the scenes.

Li Yuan (A.D. 566-635), a Chinese emperor, founded the Tang dynasty (A.D. 618-907). Historians consider this dynasty one of the greatest periods in Chinese history. Li Yuan reigned from 618 to 627. He established Tang control over rebellious sections of central and south China and defeated a Turkish invasion from the north.

Li Yuan was born in Chang'an (now Xian) of a noble family. He became a general and served from 615 to 617 as military commander in Shanxi province in north China. Li was loyal to the emperor until 617. In that year, Li's son Li Shimin persuaded him to rebel. Li Yuan's forces captured Chang'an, the western capital of the ruling Sui dynasty. In 618, the Sui ruler was murdered during a rebellion and Li became emperor. In 627, Li Shimin forced his father from the throne and became the second emperor of the Tang dynasty.

See also **China; Tang dynasty.**

Liability insurance. See **Insurance** (Property and liability insurance).



Lianas are vines that climb tree trunks or other objects.

Liana is the name for various vines found chiefly in tropical rain forests. Lianas climb on or around the trunks and branches of trees, using the trees for support. They have flexible shoots and grow rapidly.

There are several types of lianas. Some, called *scramblers* or *leaners,* have no special structures for support. They lean against trees as they climb. Other lianas, including the kudzu vine and some kinds of honeysuckle, twine around trunks and branches. Many lianas have threadlike tendrils that attach to nearby vegetation or other objects. These include grapevines, greenbrier, and Virginia creeper. Other lianas, such as ivy and vanilla vines, use *adventitious roots* (roots formed away from the primary root) as a means of attachment. Still other lianas, including some bougainvillea, have hooked thorns or prickles for climbing.

Libel is a written, printed, or other statement in a permanent form that harms a person's reputation. Pictures, signs, and information broadcast on either radio or television may be libellous. *Slander* is similar to libel. However, slander involves spoken words or a statement uttered that damages a person's reputation. In countries that allow slander cases, the victim of a slander must be able to show he or she has suffered actual damage. In a libel action, proof of damage is generally not necessary. Libel and slander are both forms of *defamation*. Individuals are most often the subject of libel, but a company or corporation may sue for injury to its reputation.

The offence of libel does not consist of writing or developing the harmful material, but in showing it. If the writer of such harmful information shows it to another person, the writer has *published* the libel.

A person who believes he or she has been libelled can start legal proceedings in a civil court. Libel cases are usually tried by a jury. The *plaintiff* (person bringing the proceedings) must prove three things. First, the plaintiff must prove that something was published by the defendant. Second, the plaintiff must prove that the published material was about him or her. Third, the plaintiff must prove that the material was *defamatory* (damaging) to his or her reputation.

Libel laws have sometimes come under criticism. Some journalists have complained that libel cases often cost a great deal in legal fees and take years to settle. But some lawyers and media researchers believe that the courts often rule in favour of plaintiffs without requiring enough proof that their reputation has been damaged. Another criticism arises in countries where libel cases are tried by juries who also decide the amount of damages. Such juries sometimes award extraordinarily high sums to successful plaintiffs. Several cases in England in the late 1980's resulted in record damages which were later reduced on appeal.

Some countries treat libel as a crime if the statement is likely to cause a breach of the peace. In such a case, it is not necessary that the statement is published to a third person. Slander is only a criminal offence if it is obscene, blasphemous, seditious, or contempt of court.

Liberal arts are the learned habits of thought and speech considered essential for a free human being. Historically, the liberal arts included two groups of studies. One was the correct use of language (grammar), thinking clearly (logic), and expressing one's ideas persuasively (rhetoric). The second group included the various branches of mathematics. Originally, these were arithmetic, geometry, astronomy, and harmony. Out of these traditional studies have come the groupings into natural sciences, social sciences, and humanities. Colleges that concentrate on these studies are usually called liberal arts colleges.

Liberal Democrats is the name of the third largest of Britain's political parties. In its policies, the party emphasizes the rights of the individual. It attracts people who believe that changes in the life of Britain are necessary, but who reject socialism. The party has no link with any class group or special interest group. It opposes the idea that such groups should be in control of the government. Liberal Democrats believe in the *devolution* (transferring from national to local level) of power. They believe in "community politics," in which decisions are made with the active involvement of the people affected by them.

Until 1988, the party was known as the Liberal Party. The Liberals fought the 1983 and 1987 general elections in alliance with the Social Democratic Party. The *Alliance* received 7.3 million votes in 1987, gaining 22 seats in Parliament. In the same year, the Liberals and the Social Democrats agreed terms for a merger of their parties.

Overseas policy. Liberal Democrats have three main aims in overseas policy: (1) to strengthen the United Nations, (2) to increase the help given by the richer countries to the poorer, and (3) to increase cooperation between democratic countries. Liberal Democrats enthusiastically support Britain's membership of the European Community (Common Market), and believe that Britain should play a positive role in developing common foreign, economic, environmental, and agricultural policies.

Defence and disarmament policy. Liberal Democrats believe that the maintenance of collective security and the pursuit of disarmament must be considered together. The party's aim is to reduce Britain's dependence on nuclear weapons and to agree to reductions in conventional forces. Liberal Democrats support Britain's membership of the North Atlantic Treaty Organization (NATO).

Economic policy. Liberal Democrats aim to create a decentralized economy which develops partnership at work and helps people share in the wealth they help to create. Liberal Democrats believe that efficiency and responsiveness to consumers are more important issues than the ownership of businesses. The party favours competition and tight regulation of monopolies. Liberal Democrats advocate employee sharing in decisions, profits, and ownership. They favour greater democracy in trade unions, and believe in positive union rights and responsibilities.

Home policy. Early in the 1900's, Liberals laid the foundations of the Welfare State. The party now supports a comprehensive National Health Service, with increased investment. They aim to integrate the tax and benefits systems to ensure that everyone receives a minimum income. In education, Liberal Democrats advocate increasing investment and making educational opportunities widely available.

Environmental policy. Liberal Democrats favour energy conservation. They support development of nonnuclear energy sources.

Organization. Liberal Democrat members in both houses of Parliament form the parliamentary party. Associations in the constituencies are grouped in area federations. The supreme body of the party is the annual assembly, made up of delegates from constituency associations. The party also has a council, a national executive, and a policy committee. The leader of the party is chosen by ballot of all the members.

History. The Liberals grew from the Whigs of the 1700's (see **Whig Party**). In the early 1800's, some Whigs advocated parliamentary reform, abolition of civil and religious privileges, and establishment of free trade. The term *Liberal Party* was used to describe the alliance of these Whigs with the Radicals, the reform party.

Leading Liberals during the 1800's included Earl Grey, Lord John Russell, Richard Cobden, John Bright, and William Ewart Gladstone. In 1886, the party split over Gladstone's controversial Irish Home Rule Bill. Some Liberals joined the Conservative Party. The Liberals did not regain power until 1906. Liberal leaders of this period included Herbert Asquith and David Lloyd George.

During World War I (1914-1918), Lloyd George broke away from Asquith and formed an alliance with the Conservatives, which lasted until 1922. The Liberal Party split and the Labour Party became the main opposition to the Conservatives.

In 1981, the Liberals formed an electoral alliance with the Social Democratic Party. In 1983 and 1987, the Alliance won about 25 per cent of the vote in parliamentary elections. In 1988, most members of the two parties merged to form the Social and Liberal Democratic Party. The party took its current name two years later. In parliamentary elections in 1992, the new party won about 20 per cent of the vote.

Related articles in *World Book* include:

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United Kingdom, History of the

Liberal Party of Australia is a political party which supports individual initiative and enterprise, and is conservative on social and moral questions. It works in association with the National Party, and the two parties have formed coalition governments with anti-socialist policies. Coalition governments have had the Liberal Party's leader as prime minister.

The Liberal Party was formed in 1944-1945 by Sir Robert Menzies from the former United Australia Party. Most of its support has come from middle class voters in towns. It is organized through local, state, and territorial branches, linked by a federal executive. The supreme conference of the party is the Federal Council. The leader and deputy leader are elected by the party's members of parliament.

See also **Australia, Government of.**

Liberalism is a political and economic philosophy that emphasizes freedom, equality, and opportunity. The philosophy called *conservatism,* on the other hand, emphasizes order, tradition, and the ownership of private property. Liberals have generally favoured more rapid social change than have conservatives. But liberalism is a confusing term, because its meaning and emphasis have changed considerably over the years.

Early liberalism. The right to rebel against a government that severely restricts personal freedom was a central doctrine of early liberalism. Liberal ideas inspired the English revolution of 1688, the American revolution of 1775, and the French revolution of 1789. Liberal revolutions led to the establishment of many governments based on rule by law and by the consent of the governed. Many such constitutional governments had bills of rights that proclaimed the individual's right to freedom of speech, the press, assembly, and religion. The bills of rights also attempted to provide safeguards against the abuse of police and judicial power.

Early liberals favoured constitutional government, but they usually distrusted democracy. They tried to restrict the exercise of political power to members of the property-owning middle class. But as the industrial working class grew larger, it adopted the liberal principle that government should rest on the consent of the governed. By the late 1800's, a liberal was a person who favoured democracy and voting rights for adult citizens.

Political and economic liberalism were closely connected until the 1900's. Early liberals believed the government that governs least governs best. They argued that all people benefit most when each individual is allowed to follow his or her own self-interest. They believed that the economy is self-regulating if left alone to operate according to its own rules. Therefore, they concluded, government regulation is unnecessary. The ideas of economic liberalism were arranged into a system by the Scottish economist Adam Smith, and discussed in his book *The Wealth of Nations* (1776). This system was called *capitalism,* or *free enterprise.*

Liberalism today. Liberalism has undergone a significant change of emphasis in the 1900's. In the late 1800's, many liberals began to think of freedom less in terms of freedom from this or that restriction, and more in terms of freedom of opportunity. They became convinced that government action is often necessary to provide the conditions under which individuals can realize their potentials.

Today, liberals favour active government regulation of the economy in the public interest. They support government programmes to provide economic security and ease human suffering. Such programmes may include unemployment insurance, minimum-wage laws, old-age pensions, health insurance, civil rights legislation, and various antipoverty measures. Modern liberals believe in the primary importance of individual freedom. But they maintain that government must actively remove obstacles to the enjoyment of that freedom.

See also **Conservatism; Political science** (Liberalism).

Liberia is a country on the west coast of Africa. It is the world's second oldest independent nation of mainly black citizens. Only Haiti is older. Liberia was founded in 1822 by freed slaves who were sent there by a colonization society in the United States. These freed slaves were joined by others who had been freed from slave ships bound for the United States. The name *Liberia* is derived from a Latin phrase meaning *free land.*

Liberia covers 111,369 square kilometres. It has a hot, humid climate. For Liberia's total population, see the *Facts in brief* table with this article. More than half the people live in rural areas and farm the land for a living. Monrovia, the country's capital and largest city, is named after U.S. President James Monroe, who arranged for the development of the settlement of Liberia.

Government

In 1990, rival governments were established during a civil war in Liberia. In 1994, a transitional government that included members of Liberia's three main political factions was established. It was to govern until elections could be held. After the elections, the form of government was to return to what it had been before the rival governments formed. The section below describes Liberia's government before the split in 1990.

A president headed Liberia's government. The voters elected the president to a six-year term. The president appointed a Cabinet to carry out the functions of the government. The legislature passed the nation's laws. It consisted of a 26-member Senate and a 64-member House of Representatives. The voters elected senators to 6-year terms and House members to 4-year terms. All citizens 18 or older were allowed to vote. Liberia was divided into 13 counties. Each county had a superintendent appointed by the president.

A Supreme Court headed Liberia's main court system. The Supreme Court had a chief justice and four associate judges. All supreme court judges were appointed by the president. Another court system judged cases based on African customary law.

People

Almost all of Liberia's people are black Africans. Small groups of Americans, Europeans, Lebanese, and Asian Indians also live in the country. The African population is made up of two main groups—the *indigenous* (native) Africans, whose ancestors have lived in the area for hundreds of years; and the Americo-Liberians, who are descended mainly from African American settlers sent from the United States.

The indigenous Africans account for about 95 per cent of Liberia's population. They are divided into 16 ethnic groups, each of which has its own language, customs, history, and territory. The largest groups are the Kpelle, who live in central Liberia, and the Bassa, who live along the coast. Other groups include the Gio, Krahn, Kru, Mandingo, and Mano.

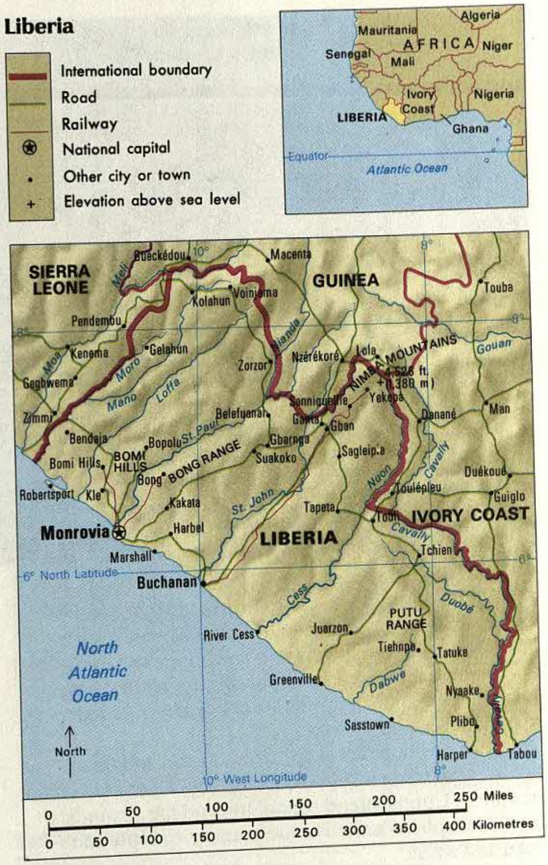
The Americo-Liberians make up about 5 per cent of the population. They live in coastal cities and towns. In general, the Americo-Liberians have been far better off than the indigenous Africans. Before a group of indigenous Africans revolted in 1980, Americo-Liberians controlled the country's political system. The revolt brought indigenous Africans to power.

City life. About half of Liberia's population live in urban areas. Some people live in expensive homes, but most live in small, tin-roofed wooden houses. The cities of Liberia have large buildings and shops, cinemas, and busy streets. Many city and town dwellers have electricity and running water in their houses.

Facts in brief about Liberia

Capital: Monrovia.
Official language: English.
Area: 111,369 km². *Greatest distances*—east-west, 370 km; north-south, 338 km. *Coastline*— 507 km.
Elevation: *Highest*—Nimba Mountains, 1,380 m above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 1996 population*—3,136,000; density, 28 people per km²; distribution, 56 per cent rural, 44 per cent urban. *1984 census*—2,101,628. *Estimated 2001 population*—3,675,000.
Chief products: *Agriculture*—rubber, cassava, rice, coffee, bananas, cacao. *Forestry*—mahogany. *Mining*—iron ore.
National anthem: "All Hail Liberia, Hail."
Flag: The flag has 6 red and 5 white horizontal stripes that represent the 11 signers of the Liberian Declaration of Independence. A white star appears on a dark blue canton in the upper left corner. Adopted in 1847. See **Flag** (picture: Flags of Africa).
Money: *Currency unit*—Liberian dollar. One dollar = 100 cents.

Liberia



People who live in urban areas work in schools, shops, factories, and government offices. Many also work as carpenters, doctors, taxi drivers, or servants. Many women who live in urban areas travel to rural areas daily to work on farms. Family life is important in Liberia. Extended families—in which married children and their offspring live with the parents—are common in the cities.

Rural life. In the rural areas, people live in small villages. Most people live in mud houses with thatched roofs. Almost no homes in rural Liberia have electricity or indoor plumbing.

Most people in rural Liberia work as farmers. Many people who live along the coast fish for a living or work aboard ships. As in the urban areas, extended families are common in Liberia's rural areas.

Religions and languages. About 30 per cent of Liberia's people are Christians, and about 20 per cent are Muslims. However, most Liberians—especially those in rural areas—follow traditional religious beliefs of their ethnic group.

English is Liberia's official language. It is used in government and business and is taught in the schools. Each African ethnic group has its own language, and some also have several distinct dialects.

Education. Liberia's school system includes six years of primary school and six years of secondary school. The government supports some of Liberia's schools. Others are run by missionaries. By law, children must attend

Monrovia is the capital and largest city of Liberia. It stands on the Atlantic Coast of Africa at the mouth of the St. Paul River.

all 12 grades. However, only about 60 per cent of the children fulfil this requirement. School attendance is much lower for girls than for boys. Liberia lacks an adequate number of schools, especially in the rural areas. The country also has shortages of teachers and teaching materials.

Liberia has one university, one college, and three technical or trade institutions. Less than 1 per cent of the people of Liberia attend school beyond the secondary level. Only about a third of the country's people can read and write.

Land and climate

Liberia has a rugged coastline. A narrow coastal plain extends inland from the coastline, and the land gradually rises to a plateau region with low hills. This region includes the Bomi Hills and the Bong Range. Higher elevations of the plateau region have forests of evergreen and deciduous trees, including ironwood and mahogany. Its valleys have grasses with scattered trees. Highlands in the northern and northwestern parts of Liberia include the Wologizi and Nimba mountain ranges. Liberia's most important rivers are the Cavally (also spelled Cavalla), which forms Liberia's border with the Ivory Coast; and the St. Paul, which flows through the mountains in the north.

Liberia's climate is hot and humid. The country has an average annual temperature of 27° C along the coast. Most of Liberia has a dry season and a rainy season. On the coast, the dry season lasts from December to March. However, the dry season lasts longer in inland areas of the country. Annual rainfall on the coast of Liberia averages 510 centimetres. Inland areas receive about 220 centimetres of rain each year.

Liberia once had much wildlife. But hunters killed most of the wild animals. Some elephants, crocodiles, pygmy hippopotamuses, antelopes, and leopards still live in the east and in the northwest.

Economy

About 75 per cent of Liberia's employed people work in agriculture. But agriculture contributes only about 20 per cent of Liberia's *gross domestic product* (GDP). The GDP is the total value of all goods and services produced in the country within a year. Service industries account for about 54 per cent of Liberia's GDP and employ

The Temple of Justice in Monrovia is one of Liberia's most modern buildings. Liberia's Supreme Court meets in the building to hear cases.

about 16 per cent of the work force. Mining accounts for about 14 per cent of the GDP and employs about 6 per cent. Manufacturing and construction together account for about 12 per cent of the GDP and employ about 3 per cent.

Agriculture is the chief occupation in Liberia. Many Liberian families grow crops on small plots of land owned by their communities. Cassava, rice, sugar cane, and tropical fruits are the chief food crops. Most of the farmers also rear sheep, goats, pigs, and other livestock. Most Liberian farmers use old-fashioned farming methods, and few have modern farm machinery. Liberia's farmers produce goods mainly for their own families, and so there is little to sell to city-dwellers. As a result, the country must import much of its food.

Large rubber plantations owned by foreign companies employ many Liberians. Farmers on these plantations use modern methods to produce rubber, Liberia's main agricultural export. Other export crops include *cacao,* which is used to make cocoa, and coffee.

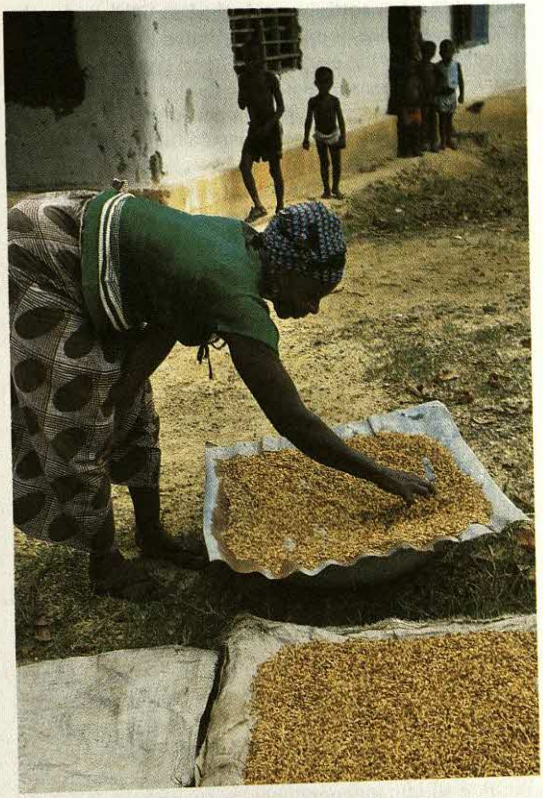
Liberia has some large forest areas. Timber cut from these regions is exported, used for firewood, or for the construction of houses.

Service industries are economic activities that produce services rather than goods. Such industries have become increasingly important to Liberia's economy. The country's most important service industries are government activities, finance, insurance, and property development.

Mining. Almost all of Liberia's mining income comes from iron ore, the country's most valuable export. A company jointly owned by Italians and Germans mines iron ore in Liberia. Liberian prospectors mine small amounts of gold and diamonds.

Manufacturing. Factories in Liberia process farm, forest, and mining products. The country has an oil refinery, and factories that produce soap, beverages, and explosives.

Workers tap rubber trees and collect latex on plantations. Rubber has been a chief source of income since the 1930's.



Farmers in rural Liberia live in small villages. Liberia's farmers grow food mainly for their own families. In the picture above, a woman sets out grain to dry in the sun.

Transportation and communication. Most of Liberia's roads are unpaved. Railways built by mining companies carry freight between the companies' mines and ports in Monrovia and Buchanan. Monrovia has two airports. Few Liberians own a car. City dwellers usually walk or take taxis or buses. Most rural Liberians travel on foot.

The largest merchant fleet in the world is registered under the Liberian flag. But only a few ships are owned by Liberians. The rest are owned by people from other countries who register their ships in Liberia because taxes are lower there.

Liberia has 3 daily newspapers. The country has an average of about 1 radio for every 4 people. Less than 2 per cent of all Liberians own a TV set.

History

Early days. The ancestors of today's native Liberians probably came from kingdoms in Sudan between the 1100's and the 1500's. In the 1400's, Portuguese explorers began to trade with the people who lived along the coast of what is now Liberia. The Portuguese traded for ivory, spices, and slaves who were taken from the inland region. The traders greatly prized a spice called malagueta pepper, which they called the "grain of paradise." Thus, the region became known as the *Grain Coast.*

The Liberian settlement. In the late 1700's and early 1800's, many white people in the United States became concerned over the existence of freed slaves in their country. Some slaveowners believed that the existence of freed slaves increased discontent among those still in slavery. Other white people objected to the integration of the black freed slaves into their society. In 1816, a group of white Americans established the American Colonization Society (ACS). The goal of this society was to return free blacks to Africa. The society bought land along the Grain Coast from inhabitants of the region and started a settlement. They named the settlement Monrovia, after President James Monroe. In 1822, the first group of freed slaves arrived at the settlement by ship. These settlers were joined by many black Africans whom the U.S. Navy had removed from ships that were illegally transporting slaves.

The settlers faced many difficulties. They had trouble finding sufficient food, and many died from disease. The indigenous Africans, who feared losing their land to the Americo-Liberians, often attacked the settlers.

In 1838, the Monrovia settlement joined with others that had been established in the region to form the Commonwealth of Liberia. The commonwealth handled some of its own affairs, but it was controlled by the ACS. Joseph Jenkins Roberts, an Americo-Liberian from Virginia, became governor. Jenkins tried to increase trade income by establishing *customs duties* (taxes on imports and exports). But European traders refused to recognize the right of the commonwealth to do so. Disputes also arose between the settlers and the ACS. Many Americo-Liberians sought independence, and members of the ACS resented the expense of supporting Liberia. Liberia became an independent nation on July 26, 1847. Roberts became its first president.

The Republic of Liberia. The customs duties Liberia placed on its imports and exports increased the cost of trading with the country. Liberia's trade declined and its economy suffered. In the late 1800's and early 1900's, Li-

The Liberty Bell, *above,* is a symbol of American independence. It was rung each year from 1776 until 1835, when it cracked while being rung at the funeral of Chief Justice John Marshall. In 1976, the bell was moved from Independence Hall to the Liberty Bell Pavilion in Philadelphia, *below.*

beria's government was forced to take large loans in foreign countries to pay its bills.

In 1926, the government agreed to lease large amounts of land to the American Firestone Company for rubber plantations. The rent provided important income. The plantations also created jobs for many Liberians.

William Tubman became president of Liberia in 1944. Tubman was determined to develop the economy and to integrate the Americo-Liberians and indigenous African populations. During Tubman's rule, foreign trade expanded and the mining of iron ore experienced considerable growth. Some of Tubman's policies aimed at providing more political and economic opportunities for the indigenous Africans.

Recent developments. Tubman died in 1971. He was succeeded by Vice President William R. Tolbert, Jr., another Americo-Liberian. Tolbert tried to follow Tubman's policies, but he faced major problems. Iron ore and rubber prices dropped, and Liberia's economy suffered badly. In 1979, a rise in the cost of rice caused riots and looting as people demonstrated against the price rise. Under Tolbert's rule, the rich prospered while the poor became poorer.

In 1980, a small group of military men from the indigenous Liberian population killed Tolbert and took control of the government. They installed Samuel K. Doe, an army sergeant, as president. A new Liberian Constitution was approved in 1984. In 1985, elections were held to choose a president and a legislature. Doe was declared winner of the presidency, and his party—the National Democratic Party of Liberia—was awarded a majority of seats in the legislature. However, many people believe the elections were *rigged* (fixed) by Doe and his supporters. Doe's new government took office in 1986.

A rebellion against Doe began in December 1989. In 1990, it developed into a bloody civil war. Two rebel groups—the National Patriotic Front of Liberia (NPFL) and the Independent National Patriotic Front of Liberia (INPFL)—fought with each other and with the Armed Forces of Liberia (AFL). The NPFL and INPFL consist mainly of members of Liberia's Gio and Mano ethnic groups. The AFL consists mainly of Doe's ethnic group, the Krahn, and the Mandingo. In September 1990, the INPFL captured and killed Doe. After Doe's death, the three groups continued to fight for control of the government. West African peacekeeping forces were sent to Liberia. In November 1990, all parties agreed to a cease-fire. A government was established and took control of the capital. The NPFL controlled much of the countryside. In October 1992, the NPFL attacked the capital, and fighting resumed among rebel groups. The warring parties agreed to a cease-fire in 1993, but fighting continued. In September 1994, the leaders of the NPFL, the United Liberation Movement of Liberia for Democracy (ULMLD), and the AFL leader agreed to share power. Fighting then decreased in the country.

See also **Monrovia; Tubman, William V. S.**

Liberty. See **Freedom.**

Liberty, Statue of. See **Statue of Liberty.**

Liberty Bell is a treasured relic of the early days of American independence. It was rung on July 8, 1776, with other church bells, to announce the adoption of the Declaration of Independence. Its inscription, "Proclaim Liberty throughout all the land unto all the inhabitants thereof," is from the Bible (Lev. 25:10). The Liberty Bell weighs over 943 kilograms. It now hangs in Liberty Bell Pavilion, in Philadelphia, Pennsylvania.

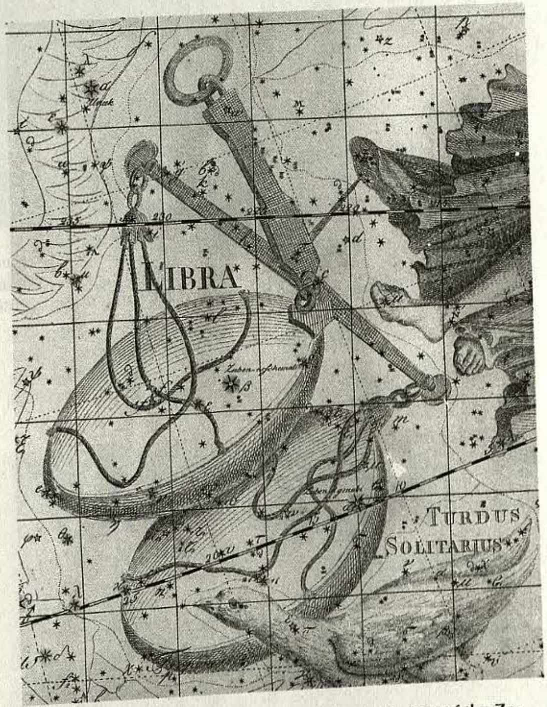
Libido is a psychoanalytic term referring mainly to the energy of natural instincts or urges that motivate behaviour. Austrian doctor Sigmund Freud was the first to use the term (see **Freud, Sigmund**).

Some psychoanalysts believe that the libido develops through certain stages. In the *oral* phase, the infant derives pleasure from such activities as sucking and biting. In the *anal* phase, the child obtains satisfaction and interest in bowel control. In the *genital* phase, sexual instincts are organized for the purposes of love and sexual reproduction. Some psychoanalysts believe problems in the development of the libido and its expression can cause character disorders and symptoms of the milder mental illnesses called *neuroses.*

See also **Psychoanalysis** and its *Related articles.*

Libra, the *Scales* or *Balance,* is the seventh *constellation* (star group) of the zodiac. It lies in the Southern Hemisphere between the constellations Virgo and Scorpio. Libra is the only sign of the zodiac that is not symbolically represented as a living thing. Originally, the Ancient Greeks named Libra *Chelae Scorpionis,* the claws of the neighbouring Scorpion constellation. The most interesting celestial object in Libra is the eclipsing *binary* (double star) Delta Librae, which varies in magnitude every 2.33 days. Alpha Librae, also called Zubenelgenubi (the southern claw), is a blue-white double star which is visible through binoculars.

See also **Astrology; Horoscope; Zodiac.**



Libra is a group of stars that forms the seventh sign of the Zodiac. This illustration is from *Uranographia* by Johann Boole, published in 1801.

Libraries play an important role in the education, work, and recreation of millions of people. Many public libraries, such as the one above, offer a variety of materials and services in attractive surroundings. The people in the foreground are using computer catalogues to find books.

Library

Library. Libraries form a vital part of the world's systems of education and information storage and retrieval. They make available—through books, films, recordings, and other media—knowledge that has been accumulated through the ages. People in all walks of life—including students, teachers, business executives, government officials, scholars, and scientists—use library resources in their work. Large numbers of people also turn to libraries to satisfy a desire for knowledge or to obtain material for some kind of leisure-time activity. In addition, many people enjoy book discussions, film shows, lectures, and other activities that are provided by their local library.

Libraries play an important role in preserving a society's cultural heritage. For example, some libraries have special collections of such items as rare books, authors' or composers' original manuscripts, or works by local artists. In addition, the librarians in many libraries develop exhibitions and offer programmes to help people learn about their own community or about the culture of other civilizations. All in all, the library ranks as one of society's most useful service institutions.

The first section of this article, *The Library Today,* provides a survey of the varied contents and kinds of libraries, and discusses the many services these important institutions provide. It also deals with the challenges and problems faced by librarians and libraries. Then the article describes in detail the different types of libraries that are designed to serve different people. The article discusses libraries in all parts of the world.

The library today

Today's libraries differ greatly from libraries of the past—not only in contents, kinds, and services, but even in physical layout and atmosphere. In turn, future libraries will differ from those of today. This is so because librarians constantly strive to find ways to expand and perfect the contributions that they and their institutions make to society.

Contents and kinds of libraries. Libraries throughout the world show great variation in terms of both contents and kinds.

Variety of contents. The contents of libraries have changed so much through the years that the word *library* itself is, in a sense, inaccurate. The word comes from the Latin word *liber,* which means *book.* It shows that libraries traditionally were largely collections of books. Today's libraries house many books, of course. But, they also have a wide variety of other materials that inform, educate, and entertain. These materials include magazines, newspapers, pamphlets, disc and cassette tape recordings, films and videos, photographs, microreproductions, computerized databases, paintings, musical scores, and maps. In addition to ordinary books, a library may have large-print books and braille books for use by readers with impaired vision.

People interested in music, for example, can learn much by reading library books on the topic. They can add a great deal to their understanding and appreciation of music by listening to a library's musical recordings. Students of agriculture can learn from books about how crops are grown and can widen their understanding by watching a library film or video on the process. Many people use libraries to study current events. Library collections of magazines and newspapers provide the most up-to-date and detailed printed material in the field. But many libraries also have access to computerized news services or to videotex services through television. A library that owns recordings, braille books, talking books, and large-print magazines and newspapers can be of invaluable assistance to partially sighted or blind users.

Variety of kinds. In addition to expanding contents, librarians have developed many kinds of libraries to serve the information, recreation, and education needs of different people. College, university, and research libraries maintain large collections of detailed research materials for advanced students and scholars. School libraries have collections that provide the more basic information needed by primary and secondary school students. Public libraries tailor their collections to a broad cross-section of the public. Government library collections are geared chiefly toward serving the needs of government officials. Thousands of special libraries provide information for professional people, such as advertising executives, bankers, editors, engineers, historians, journalists, lawyers, doctors, teachers, and scientists.

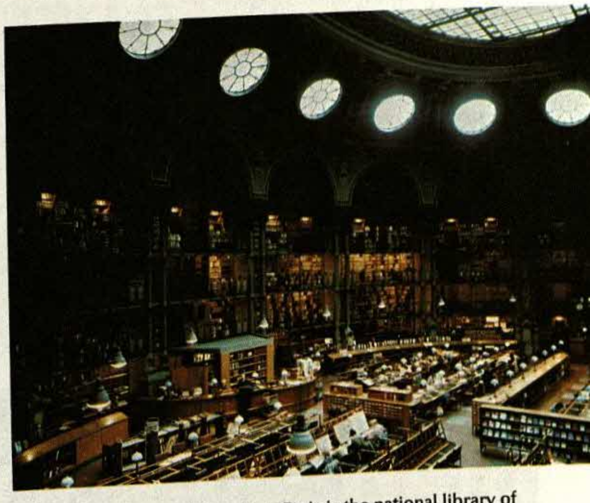
Library services. Libraries today are a widespread, vital service institution. In many parts of the world, library materials are available to anyone who wants to use them. Research libraries have extended library services far beyond making materials available. They offer many forms of assistance to library users. Librarians also work to interest people in library use, and they engage in a variety of activities that make the library an active force in society.

Providing materials. Viewed historically, the library's role of making materials available ranks among the most important contributions ever made to human culture and technology. Libraries have long stored materials that enable ideas, knowledge, and experiences to be passed on from generation to generation. Without this line of communication, cultural and technological developments would not be as advanced as they are.

Viewed as a factor in day-to-day life, the library's materials serve as important resources in the education, work, and recreation of millions of people. To students, the library is a place where they can find materials that help them carry out their school or college work. It is also a place where they can pursue knowledge beyond their classrooms and beyond their textbooks.

Professional people in many fields rely on materials in special libraries for information they need in their work. Before going into court for a legal case, for example, a lawyer may spend hours in a law library finding and studying cases to prepare arguments. Doctors use medical libraries to obtain information they need in order to treat unusual or complicated diseases. Many business executives find various library materials to be of great value in their work.

School libraries serve students by providing materials for a wide range of purposes and interests. The children in the library shown above are studying some of its collection of paintings and art books to help them with a school project.



The Bibliothèque Nationale in Paris is the national library of France and a world centre for scholarship. This picture shows one of its reading rooms. The shelves in the background hold part of the library's collection of about 500,000 magazines.

For many people in all walks of life, the library is a place from which to get materials for leisure activities. Reading, looking at films or videos, and listening to recordings rank among the most popular leisure activities, and libraries supply materials for all of them. Large numbers of people use a library to help them carry on a hobby. For example, stamp collectors can find books, pamphlets, and other materials to aid them. Amateur furniture makers can find instructions for building various pieces of furniture. Other people visit a library frequently just to browse for something, such as a novel, that will capture their interest and provide a few hours of relaxation and escape from the day-to-day world.

The job of providing materials for library users is a challenging one. To do it well, a librarian must constantly stay aware of new publications and older materials that continue to be of value. The librarian evaluates vast amounts of materials—either through personal inspection or by reading reviews—and decides which ones should be available in the library.

Since library budgets are limited, the amount of desirable material always exceeds the amount that can be afforded. Therefore, a librarian must have skill in money management, as well as good judgment about users' needs and the ability to keep informed about publishing developments. After new materials are purchased, a librarian catalogues and classifies them and arranges them in the library so that users can locate them easily.

Assisting the user. The service provided by librarians goes far beyond getting and arranging library materials. Librarians help anyone who wants assistance in finding information. In all kinds of libraries this service involves teaching people how to use library resources, helping them find material to answer their questions, and supplying answers to their questions. If the library lacks some material a borrower needs, the librarian may obtain it through the library's interlibrary loan system or try to direct the borrower to a source where the material can be found.

Many libraries have a *reference service* or *information service* for answering users' queries. A reference librarian may be called on to answer any kind of question. These include basic reference questions, such as "Who was the first president of the United States?" and "Which is the longest river in the world?" Other questions require more complicated answers, such as telling a user how a hummingbird hovers or how wastepaper is recycled. Some libraries have librarians who receive and answer basic questions by telephone. This service saves much time for library users. Reference librarians deal increasingly with social issues as libraries increase their community-service activities. Librarians also often help organizations prepare programmes on such social problems as drug abuse or environmental pollution.

Active community service. All libraries serve some kind of community—a town, city, nation, school, college, or business. All offer the basic service of providing materials and assisting the public. But librarians also devise many more ways of serving their communities.

Public libraries offer a wide range of services that the community can benefit from and enjoy. Most of them make material available through a main library, branch libraries, mobile libraries or bookmobiles, and services within hospitals, nursing homes, and prisons.

In addition, many libraries reach out into the local community by providing community information services, often in conjunction with a local service agency. For example, a library may offer information on special employment opportunities within its local area. Other services offered might include news (through the medium of a newspaper column, a spot on local radio, or a library newsletter), or an index to the local newspaper, or a guide to an important local collection.

School libraries supply materials that students and teachers need for learning and teaching, and the librarians teach students how to use a library—a skill that will benefit them throughout their lives. School librarians may also take part in curriculum development and changes and serve their school in a variety of other ways. Government libraries supply government officials with materials they need in their work. But they also distribute materials to other libraries in the country and help to coordinate the activities of all the libraries. See also the following sections of this article for discussions

Music lovers relax while listening to their favourite recordings in the audio section of a library. Many libraries have collections of tapes and records that the public may use in the library or borrow for use at home.

Music helps tell a story during a story-telling session, *above.* A skilful storyteller not only entertains young library patrons, but also can help encourage children to read on their own.

of library services: *Public libraries; School libraries; College, university, and research libraries;* and *Special libraries.*

Other features. The contents, kinds, and services of libraries have all been improved through the years. But improvements extend even further. Librarians today realize that pleasant, comfortable surroundings aid patrons in their studies. Many libraries of the past would seem somewhat dark, dismal, and unattractive by today's standards. Modern libraries are planned so that there is plenty of light from windows and artificial lighting systems. The arrangement of furniture and fixtures is both appealing and an aid to ease of use. The buildings of many modern libraries rank among the most attractive in their communities—both inside and out.

Within the library buildings themselves, librarians try to provide easy access to library materials. Many do so through the *open-stack* or *open-shelf* system. This system allows borrowers to go through library materials themselves. They can inspect the material firsthand and thus decide whether it will be useful to them. The system differs from the *closed-stack* or *closed-shelf* system, under which borrowers must ask librarians to get material for them. This can be a time-consuming procedure but may be essential when rare books or sensitive materials are involved.

Challenges and problems. In spite of all their progress, libraries—like all institutions in today's complex world—face many challenges and problems. A major challenge for libraries is how to keep up with the rapid growth of information. Important problems include providing adequate finances to support library services, developing security measures to protect valuable library materials, developing and applying effective techniques for the preservation of rare and historically significant materials to ensure that they are available to future generations of users, and resolving difficulties related to the practice of photocopying and to the controversy over censorship.

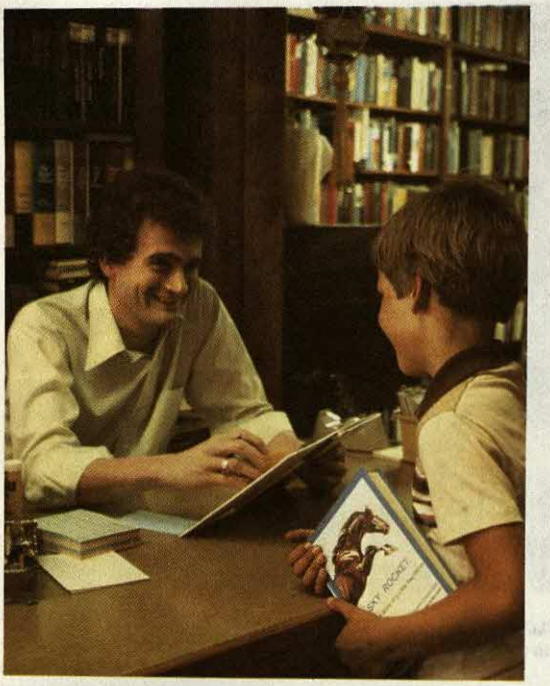
The growth of information. Each year, more and more information becomes available about every subject that interests people. The volume of material published on almost every general topic doubles every 10 to 20 years. In addition, this huge body of information is available in many different forms.

The amount of material in what some sociologists call *The Information Society* poses challenges for librarians. It means that librarians must keep informed about more materials in a wider variety of formats than ever before and be more selective in their purchases. As a library increases its purchases, the librarian's job of arranging and storing materials becomes harder. The amount of information also makes more difficult the job of locating materials for users.

Fortunately, the tools with which librarians work are improving. There are more and better guides, indexes, and catalogues than ever to help librarians locate what people want. Much cataloguing is now done centrally or cooperatively, so that the task does not have to be repeated in each library.

Many of the tools that help librarians deal with problems caused by the growth of information result from technological advances. Microreproductions, of which microfilm and microfiche are the best known, make it possible to store information in less space and, sometimes, at lower cost than ever before. It is now possible to reproduce an entire book on a microfiche not much bigger than a playing card. If such a microfiche "book" could be sold in huge quantities, it would cost little.

Computers are another technological advance that



A librarian's work often requires day-to-day contact with people—listening to them and answering their questions. Many librarians find such personal contact richly rewarding.

help libraries. They are used to keep records involved in various jobs, such as ordering, cataloguing, and circulating books. Computer-based catalogues called *on-line public access catalogues* have replaced the card catalogue in many libraries. Other advanced systems combine computers, television, and telephones and make it possible for libraries to offer various services in homes.

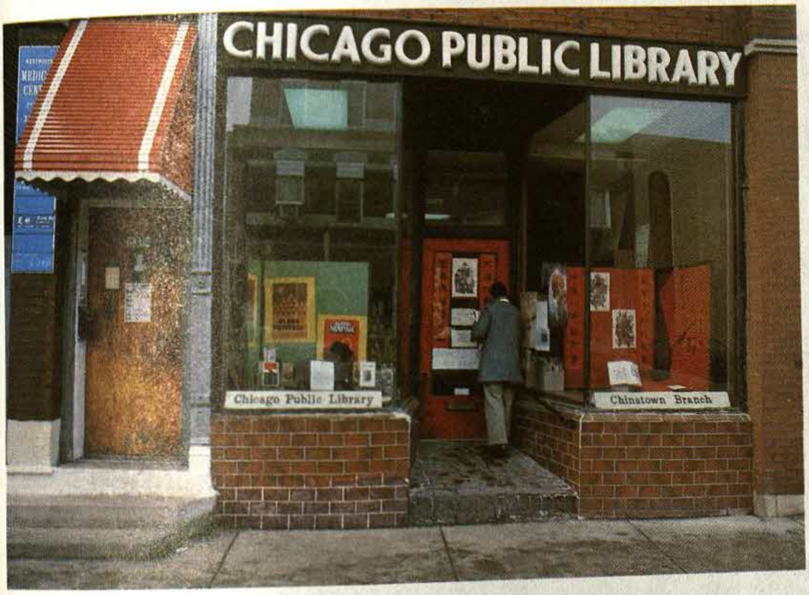
Participation in *library networks* and *library systems* also helps librarians deal with the growth of information. Library networks and systems enable a group of libraries to share information, materials, and services. Such networks also can help participating libraries organize their collections and plan improved services. Some networks serve only a certain kind of library, such as an academic and research library. However, many networks and most systems are organized to serve a specific geographical area.

To be effective, the libraries in a network or system must be linked together by communications links. These links speed the sending of questions and answers about the availability of books and other materials. Some systems pick up and deliver materials from one library to another. Many library networks and systems already exist, and the trend toward them continues to grow. By means of inter-library loans and similar reciprocal borrowing privileges among libraries and through use of microreproductions, computers, facsimile transmission, and other communication aids, a person in a library may someday have quick access to much of the world's recorded information.

Finances. Libraries—like schools, hospitals, and other institutions—face financial problems. Public libraries and state school libraries get most of their funds from taxes or rates. Local taxes are the traditional source of funds, although in some countries, central governments also have contributed to the development of these libraries. Other libraries are privately supported by the organizations that run them and by private donors.

The funds available from both public and private sources are limited, and all libraries work within budgets. Rising costs for salaries, materials, and equipment, along with increased demands for library services, put a severe strain on library budgets. The librarian's job of

A library network helps librarians deal with the information boom. Computer terminals operated by this library, *left,* link over 6,000 other libraries in the United States, Canada, Mexico, and Britain.



Shopfront libraries are one of several ways that libraries in some countries have spread their services. Such libraries as the one on the left enable people to obtain library materials in their own neighbourhoods.

choosing the best available material and the most useful services for a library thus becomes increasingly difficult. In addition, all libraries—whether their funds come from public or private sources—must compete with other institutions and other sectors of society for funds.

Security. Each year, libraries lose large amounts of valuable materials through theft. Librarians use various methods to fight this problem. Some libraries have adopted security systems. Under one such system, people leaving a library are required to pass through a turnstile at which a guard is stationed. The guard tries to detect anyone who is leaving the library with material that has not been through the library checkout. Some libraries use electronic and magnetic devices to detect attempted theft. Materials sensitive to electric or magnetic impulses are put into library items. If a person tries to leave the library with an item that has not been checked out to him or her, the substance sets off an alarm at the library exit.

Photocopying, or *photographic copying,* is the practice of making copies of parts of books, magazines, newspapers, and pamphlets for users. The practice is a valuable aid to the librarian's work and to the user. For example, people doing major research projects may need material from parts of dozens of books. They can get copies of the information they need from each book. Thus, they have permanent possession of the material they need, and they have it in a form much reduced from the bulk of dozens of books.

Copyright laws regulate the reproduction of published material by photocopying. The laws provide for some photocopying by libraries or users without permission from or payment to the holder of the copyright. The copyright rules forbid "systematic" copying in an attempt to avoid buying published materials. But the copyright laws do allow a limited exchange of photocopies among members of a library network or system, as long as such sharing does not deprive the publisher of sales. Some librarians believe that these photocopying restrictions hamper public use. Publishers respond that people may do any amount of photocopying they wish if they obtain permission and pay royalties to the holder of the copyright.

Preservation. Almost all libraries face a serious problem in seeking to preserve valuable and often irre-

A library consultant, such as the one above, helps clients obtain information from libraries. Librarians also serve the general public, students and teachers, and public officials.

The children's section of a public library is usually intended to be attractive and exciting in its design. Colourful posters, a gingerbread playhouse, and furniture, *left*, may help attract youngsters to this section. Librarians use many methods to make public libraries appealing to all members of a community.

placeable materials. Books, documents, photographs, maps, and other items are fragile objects, and careless handling or even routine use can cause damage to them.

The paper on which books and other documents are written is made of an organic substance and rots away over a period of time. Chemicals used in the manufacture of the paper and the ink used in the writing or printing on it turn to acids that speed up the decaying process. Other factors contributing to the gradual destruction of the book or document include the process of oxidation, extreme variations in temperature and humidity, exposure to light and air pollutants, and the amount of handling that the documents receive. In some countries, documents face damage from the growth of fungi or the eating habits of certain insects. Storing documents in a strictly controlled environment in which the hazards referred to earlier can be checked, is neither easy nor cheap. However, advances have been made in the *conservation* (preservation) of paper materials. For example, it is now possible to *deacidify* (remove the acid from) paper and preserve it longer. New material can now be produced on alkaline paper that neutralizes the effects of acid buildup.

Librarians can preserve paper documents on microfilm, and many newspaper archives and academic theses now take this form. Microfilming documents also makes them easily available to a greater number of users and reduces the space-consuming activity of storing back issues of a newspaper or magazine.

Films, videos, and other audiovisual materials present their own problems of preservation. They can be stretched or damaged by extreme heat, and videotapes and audio cassettes can suffer from the effects of interference from an electrical or magnetic field. These materials must also be stored in a controlled environment.

Censorship. The question of censorship is one of the most sensitive problems for librarians. Some people believe that certain material should not be published, and, if published, should not be available in a library. Such materials include many works dealing with religion or sex and works that promote extreme political or social views. Other people oppose all censorship. Librarians often receive bitter complaints from people who support the censorship of certain materials for deciding to acquire such works, and from anticensorship people for excluding certain works. Some countries have become so concerned about censorship that they have introduced a library Bill of Rights and Freedom to Read statement.

Public libraries

Public libraries serve a far wider range of patrons than do other kinds of libraries. These libraries aim to serve all members of a community—children, young adults, and adults from all walks of life. People use public libraries for schoolwork, for their jobs, and for leisure activities. Public libraries must therefore stock a variety of books and other materials and provide many services for members of the community. Many also must employ a variety of staff members who specialize in serving various age groups.

Kinds of public libraries. Public libraries range in size from huge city, borough, or county libraries with dozens of branches to small-town libraries that occupy only one room. No matter what their size or where they are located, all public libraries have the same goal—to be of maximum service to their community.

To serve the needs of a large urban area, a borough or city library must have a vast variety of books and other materials. It also needs branch libraries to serve people in their own neighbourhoods.

The materials in most large public libraries are organized into subject areas, such as history, science, and sports. These libraries also have special sections for children, adults, and, often, young adults. In addition, they may have specialized departments to serve the research needs and the industrial and scientific interests of the community. For example, a library located in a major car manufacturing centre may have a large collection of materials devoted to the history of the motorcar.

Except in big cities, a public library does not have to be large to serve its community. A small library housed in a room or two can play an effective role if it has a good basic collection of reference books, subscribes to magazines of use to its patrons, and purchases enough new materials to keep up to date. But the essential element in any library is a librarian who makes it an active service institution and is interested in both library materials and the people who use them.

Services for children. A good children's librarian makes a public library an exciting place. The librarian's friendly, understanding attitude can make the children's department amusing and interesting. The librarian arranges the department so that young patrons can use it easily. Desks, chairs, tables, and shelves are at convenient heights for children, and the room may have pictures and other decorations to make it warm and appealing.

Children's librarians may conduct a wide range of activities to help young patrons enjoy themselves and develop an interest in the library and its materials. The librarian may also work with parent and community organizations and local schools to establish courses for the education and recreation of children. Summer courses keep children interested in books and other materials during holidays.

Services for young adults. Some large public libraries have separate departments for young adults. Young-adult departments feature materials on careers, sports, travel, and other subjects of interest to teenagers. Teenagers as a group are especially interested in such social issues as citizenship, life styles, political change, pollution, and poverty. As a result, librarians try to obtain a wide variety of materials dealing with these subjects. Librarians in young-adult departments, as well as in children's departments, must be able to guide users to suitable books in the library's other departments when necessary.

Librarians for young adults, like those for children, conduct programmes to encourage library use. Geared to the interests of young adults, such programmes might involve discussions of books, films, popular music, and current social issues.

Services for adults. The needs of adults, like those of children, change and expand constantly. Developments in every field of knowledge make it increasingly important that adults continue their education after leaving school. Public libraries can play an important role in adult education. In addition, the public library is an important source of materials for increased leisure-time activity.

A reading room in a public library has comfortable chairs for those who want to browse through a recently published book or catch up on the latest issue of their favourite magazine.

Reference librarians, such as the man shown above, are sometimes called on to help locate information.

A public library maintains a wide selection of books for adults. The selection ranges from up-to-date reference works, such as almanacs, atlases, encyclopedias, and government publications, to nonfiction works that cover the whole broad range of peoples' interests, and fiction of the past and present.

Public librarians go beyond books to provide services to adults. They help patrons search the back issues of newspapers and magazines to find articles on specific subjects. They also lend films, sound and video recordings, scores of musical compositions, prints of great paintings, and other items. Public libraries have reference librarians who answer queries from patrons.

Services for special groups. Public libraries have always served the needs of special groups, such as

A mobile library is a buslike motor vehicle used to bring library materials to people. Many public libraries operate these "libraries on wheels" as part of their effort to spread the service they provide.

people with disabilities. For example, many libraries distribute braille books to the blind. *Talking books* (recordings of books and articles) help individuals who cannot use ordinary books because of blindness, paralysis, or other handicaps.

Libraries are paying increasing attention to the needs of senior citizens. Many people nearing retirement turn to a library for help in planning the future. They seek information on such subjects as recreation, handling finances, health, and travel. Some librarians prepare book lists for senior citizens and may hold meetings where older people can discuss their interests and problems. Most public libraries make books in large print available to people with failing eyesight.

In addition to providing materials and services, some libraries help special groups in other ways. For example, a library may have a ramp at an entrance instead of stairs so that people confined to wheelchairs and anyone else who has difficulty using stairs can enter and leave easily.

Many public librarians make a special effort to help teachers by providing books and other materials for their use. Many also conduct film shows, group discussions, talks on library materials, and other activities for various community groups. Organizations seeking help from public librarians in finding material on such subjects as managing money and bringing up children may be provided with bibliographies. Many public libraries provide rooms where groups can meet. Business and industrial groups often use public libraries. For example, a public librarian might prepare a special list of books and other materials for use in a management-training conference. In communities with strong trade unions, public librarians frequently work with union leaders to further the education of workers. Some libraries provide books for factories. They also furnish books for adults who are learning to read. In effect, a good public library can be the main information source for the entire community.

Spreading the service. A major goal of public librarians is to make their services available to everyone. Mobile libraries and branch libraries help spread public library service. As another step toward this goal, libraries may participate in library networks or join together in library systems. The establishment of networks and systems, discussed in the section on *The library today,* has been a major factor in the greater distribution of library materials and services.

Administering a public library is like running any complex organization. It requires skill, experience, and the ability to deal with people effectively. The staff of a public library is headed by the director or chief librarian. This person may be responsible to a local library committee who sets policies for the library. In places that have no such body, the head librarian may be responsible to a local or national government official or education authority committee.

The chief librarian has the responsibility of carrying out the policies set by the library committee. In practice, the chief librarian often takes the lead in suggesting to the committee the policies it should adopt. For this reason, the chief librarian and the members of the committee must have confidence in one another. The chief librarian prepares the budget for the library, for approval by the board and the local government. After the budget has been established, the chief librarian makes sure the money is spent wisely and in accordance with the policies set by the committee.

The chief librarian is responsible for the public relations of the library. He or she tries to interest the public in the library through newspaper articles, radio and television programs, and other forms of publicity. The chief librarian also guides the library staff in the selection of books and other library materials. A most important duty is keeping the library free from interference by groups that want to eliminate material which disagrees with their particular point of view. A good library collection must represent many different viewpoints.

A large public library may have separate departments for adult services; young-adult services; children's services; extension services, including branches and bookmobiles; technical processes, including ordering and cataloguing library materials; public relations; personnel; maintenance; and business, including bookkeeping and other office functions. In a small public library, all these duties may be the responsibility of the chief librarian and a few assistants.

Supporting the public library. Public libraries, like all institutions, must have adequate funds to be able to serve the community. The amount of money funded to libraries out of public and private resources in different countries varies greatly.

Salaries for librarians and other personnel make up the largest part of a library's budget. A public library in a developed country may spend about 60 per cent of its annual budget for salaries, 25 per cent for new materials, and 15 per cent for maintenance and miscellaneous expenses. However, rising salaries and other labour costs make these proportions difficult to maintain, and many libraries find that their budget for new materials must be cut down to meet labour costs. In extreme cases, such cuts may lead to the selling off of library stocks.

Manchester Public Library in Manchester, England, is a building of grand, classical elegance. It was completed in 1934.

Local taxes are a common source of money for public libraries. Some municipalities set aside money for their library out of their general funds, and others collect special taxes for the library. Some public libraries have endowments or grants from private sources.

Private citizens also aid public libraries in other ways. Many communities have a local group that helps raise money for the library and acts as a public relations channel for it. Such citizen groups work to publicize or supply library services. The work of these citizen groups serves to remind the public of the importance of the library to the community.

Hemel Hempstead Central Public Library is a well-designed building serving the needs of one of Britain's major New Towns (areas of rapid development). It was completed in 1963 as an extension to a building originally opened in 1957.

A modern school library can be a multimedia centre designed to complement classroom studies and offer a variety of educational materials to students and teachers. In the library shown above, natural light and comfortable furniture help provide pleasant surroundings for students working on assignments. Individual booths offer privacy to students listening to recordings.

School libraries

Every school needs a library, even if a good public library is nearby. Throughout the school day, teachers and students use library materials in the teaching and learning process. The quality of a school's education programme depends, to a great extent, on quick access to library materials.

Today's school library serves as a centre for a wide variety of educational media. These media include books, magazines, newspapers, and pamphlets; recordings; maps, films, photographs, and paintings. In addition, some school libraries have computer terminals with access to audio and visual materials from a main information storage centre. Some libraries also may provide such equipment as cameras, projectors, and tape recorders. Many libraries allow students to use this equipment in making their own films, slides, and tape recordings for classroom assignments. To reflect the expanded role of the school library in education, many schools call their libraries *instructional materials centres, learning resources centres,* or *media centres.*

School librarians are sometimes called *media specialists.* They work closely with teachers in helping students learn to use libraries and library materials and to develop good reading and study habits. School librarians should have a specialized education in librarianship. But because school librarians work closely with teachers, they—like teachers—must be skilled in subject matter and educational processes.

Many school systems provide services that help the individual school libraries and school librarians within the systems. For example, a school system may hire a school library supervisor to help plan media programmes in the system's individual libraries. The supervisor might also coordinate the school system's media programme with the whole list of education programmes that the school provides.

Primary school libraries provide boys and girls with some of their first experiences in using a library. Children go to their school library to hear stories; to browse through, read, view, or listen to library materials; to borrow materials; and to get information for classroom assignments. In the past, young children did little independent library research. Today, some children begin independent use of the library at the earliest stage and expand their independent study as their needs and abilities increase.

A good school library provides a wide range of material for use by students and teachers. If a class is studying Egypt, for example, the teacher can take out books, magazines, and pictures about Egyptian life and records or tapes on Egyptian music for classroom use. Or the teacher might instruct the students to do independent research on Egypt at the school library, giving them an opportunity to explore, discover, and locate materials for themselves. In the library, the students may also work together in small groups, discussing research they have done or perhaps studying and listening to recordings. Some libraries have small, separate conference rooms for such activities, and many librarians believe there is a need for more of these facilities in schools throughout the world.

Secondary school libraries differ from primary school libraries in two chief ways. Most of them are larger than other school libraries because most secondary schools have more students than do other schools. Secondary school libraries also provide materials that cover a wider range of subjects and are more complex than those in libraries for the primary level. A library in a large secondary school might have separate departments for languages and literature, mathematics, science, and social studies.

In secondary school, students work on independent study projects even more than they do in primary school. Independent study is a particularly important skill for students who are planning to go on to university. Secondary school students continue the practice of sometimes working in small groups in the library.

Many schools—at all levels—have library clubs. Members of these clubs may learn about library procedures and assist in the work required to run a library. A number of librarians first became interested in their field in this way.

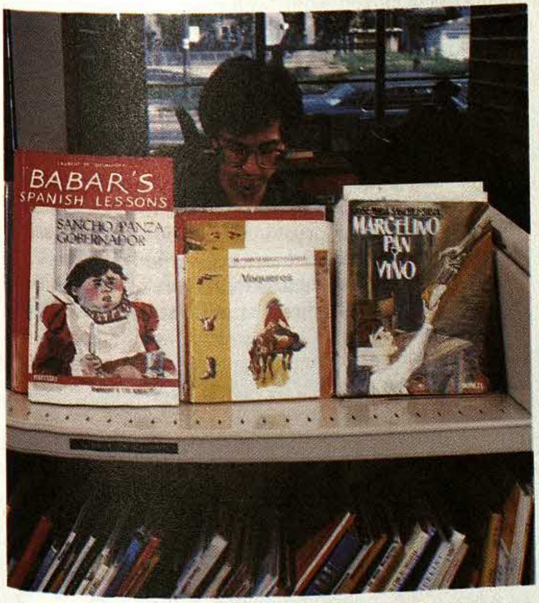
School library standards. Many schools have good library facilities, but many others do not. Some do not have even a central library. In these schools, library books are kept in the classrooms. Some schools have little or no library materials other than books. In many school libraries, the collection is too small or too out of date to serve the needs of the students. In other schools, students must rely on the public library or a visit by a mobile library.

Librarians and other educators in many countries have long called for an upgrading of all inadequate school library facilities. They urge schools to meet certain standards in library service. These standards deal with such matters as the kinds and number of materials, audiovisual equipment, and personnel that school libraries should have. In some countries, official or semi-official national library associations work out and publicize standards for school libraries.

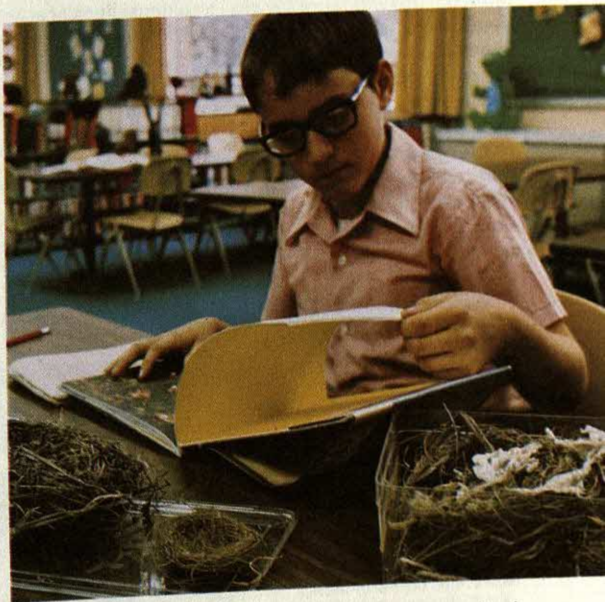
College, university, and research libraries

College and university libraries. The library is a major resource of any modern institution of higher education. College students study such a vast, fast-changing body of knowledge that few courses can be taught with one, two, or even a half a dozen textbooks. Research occupies a significant place in life at colleges and at universities. The library has a vital role in this search for knowledge. It serves as a workshop for the entire college or university—students and teaching staff alike. The world's largest university library, which contains about 10 million volumes, is at Harvard University in the United States.

A college or university library is a complex institution. It must have large quantities of books, magazines, documents, newspapers, films, recordings, photographs, and other materials to meet the demands of both students and teaching staff. Many university libraries have collections that are devoted to highly specialized subjects. Some university or college libraries contain very rare books or single copies of academic theses that cannot be consulted anywhere else. Such documents may be looked at only in the library concerned.



The display of books in this Spanish library is typical of many libraries in other European countries. Many school libraries have books and other materials in various languages to help meet the needs of their patrons.



Realia, or actual objects, are available for study in some school libraries. Such materials provide students with additional aid in their schoolwork. The boy shown above has borrowed several birds' nests to examine while he reads a book on the subject.

A rare-book collection is an example of the vast and valuable holdings of university libraries. The collection shown on the left is part of the Beinecke Rare Book and Manuscript Library at Yale University in the United States. The six-storey glass enclosure contains about 180,000 rare volumes.

A large university may have as many as 50 or more libraries in its various departments, schools, and branches. An entire library may be devoted to a single field of study, such as biology, education, music, or psychology. Such specialization of libraries gives students quick access to in-depth materials for major courses of study.

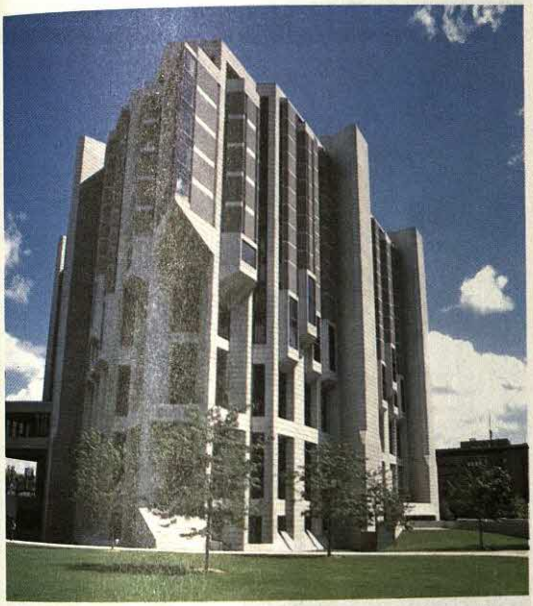
Since the 1960's, a trend in higher education has made too much subject specialization a drawback. Teaching and research in colleges and universities have tended more and more to cross traditional lines of academic disciplines. The conventional divisions of knowledge—which are reflected in departmentalized libraries—work against the crossing of traditional lines. As a result, a new movement has emerged in the college and university library field. There is a trend in libraries toward organizing large collections of books that cover broad fields of knowledge, such as the natural sciences, the social sciences, and the fine arts. Such libraries are useful to students who want information on several subjects from a general rather than a specialist point of view.

In Europe and North America, college and university libraries face problems that result from two major developments. These trends are the *information boom,* which is still going on, and the *explosion of students,* which has peaked in some countries.

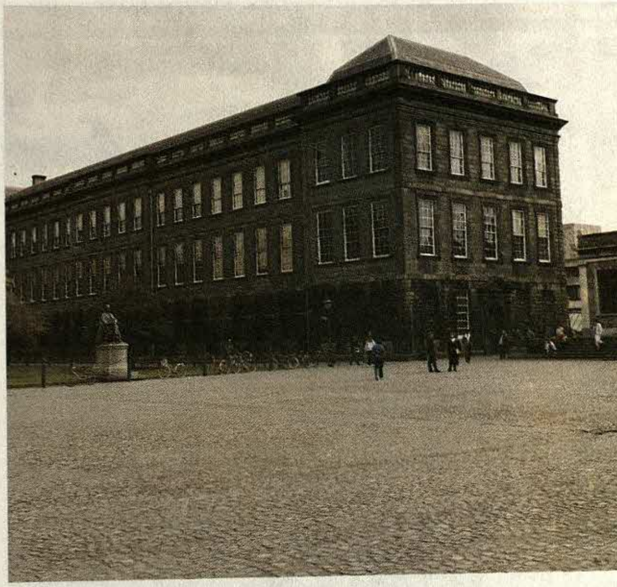
Never before has the world gained so much information so fast. Storing the results of this information boom places an ever-increasing burden on all libraries. Libraries used heavily for scholarly research—such as those of colleges and universities—are especially hard-pressed. An enormous increase in college and university enrolments has occurred along with the information boom. This is partly due to two rapid increases in population—one that took place just after World War II (1939-1945), and another in the 1960's.

Colleges and universities have taken various steps to keep pace with the demands on libraries caused by these developments. Some have launched extensive library-building programmes. They are trying to plan their new libraries in ways that will serve all students with maximum efficiency. In the past, for example, many university libraries were more concerned with the needs of postgraduate students and staff than with the requirements of undergraduates. Concern for the li-

The University Library of Delhi is an attractive centre of learning set amid beautiful parkland in the spacious and well-planned modern city of New Delhi, capital of India.



The John P. Robarts Research Library at the University of Toronto is one of the largest academic library buildings in North America. It houses humanities and social sciences collections.



The library of Trinity College, Dublin, has a million volumes, including Ireland's greatest manuscript, *The Book of Kells.* The library dates from the 1700's.

brary needs of undergraduates has increased, and some universities have even built separate libraries for these students. There is also a trend toward separate library buildings for rare books and for other highly specialized collections. Microreproductions and other aids—along with more library space—are helping college and university libraries solve the storage problem. Some libraries have begun using computers to keep track of the vast amounts of information that they are amassing.

Research libraries. Many college and university libraries function as research libraries. But several other major types of libraries also serve researchers and scholars. These libraries are not directly connected with any particular educational institution. Some of the most famous research libraries are privately controlled.

Other kinds of libraries also have outstanding resources for research. Especially important are the well established national libraries such as the British Library and the United States Library of Congress, and special libraries administered by professional associations.

Most public libraries are not mainly concerned with scholarly research, but many have collections that are useful to schools, such as the U.S. Cleveland Public Library's collection on folklore and Australia's Mitchell Library Collection of material relating to Australia and the Pacific area.

The problem of providing adequate collections of materials for the people who use them is especially difficult for research libraries. Keeping up with the thousands of new books published each year throughout the world is a vast job in itself. But even more difficult is the job of keeping up with the thousands of scholarly and technical magazines published by academies, governments, societies, and other institutions. Throughout the world, for example, there are about 10,000 medical magazines and at least 50,000 magazines in other branches of science.

No one library can own all the material that researchers might request. Researchers often need rare, out-of-print books, and books published in foreign languages. To help solve this and other problems, many research libraries cooperate in buying, cataloguing, and storing books and magazines.

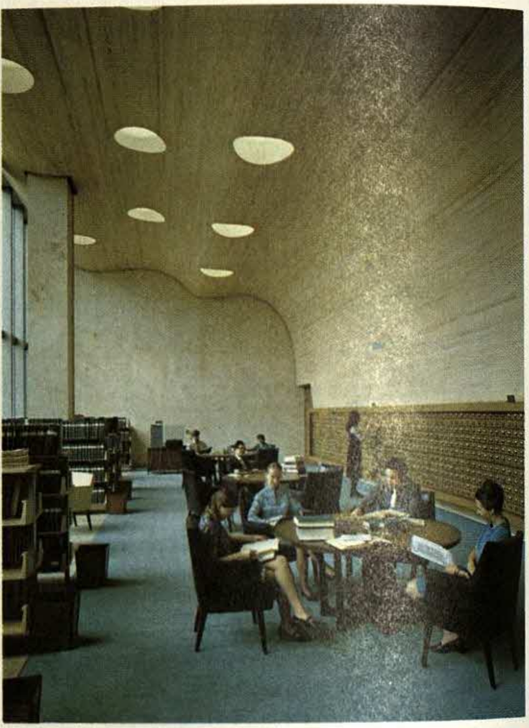
One of the chief means of cooperation is through lists and catalogues of books and magazines. Many national libraries undertake to coordinate this cooperation, producing and maintaining a national catalogue for books and other printed materials and for magazines. Many research libraries rely on computerized cataloguing systems to locate materials in other libraries. Materials that appear on the lists and in the catalogues can often be borrowed through interlibrary loans or can be photocopied. Libraries also cooperate in buying books from other countries.

Some libraries also cooperate in housing valuable, but seldom-used, books. In some countries, a central research library will serve as a storage centre for rare or seldom-consulted books. This centre may also subscribe to thousands of seldom-used journals, which other libraries may borrow.

Special libraries

Many businesses and other organizations maintain a library to serve the special needs of their workers. Such libraries fall into the general category of special libraries. They have a variety of different names, including

The collection of a special library may feature items other than books. The map library shown above, for example, has thousands of maps for the use of its patrons.



A special library at the United Nations, *above,* provides delegates with materials on international law, economic and social affairs, and other subjects related to UN work.

Information Service, Research Library, and *Technical Library.*

The library of a newspaper is a special library. It is often called a *morgue.* Other special libraries include those of a bank, of an advertising agency, or of a company that makes guided missiles. *The World Book Encyclopedia* maintains a special library for the use of its editors. Many of the research and government libraries discussed elsewhere in this article are special libraries.

The collection of a special library is tailored to the needs and goals of the organization that the library serves. For example, the materials in a chemical company's library deal chiefly with chemistry. In some fast-developing fields, special library collections may include relatively few books. To keep up with the latest developments, such libraries rely heavily on publications other than books. These publications include computer printouts, magazines and pamphlets, newspaper clippings, scientific papers, and research and reports.

The special library is taking on increasing importance with the rapid developments in all fields of knowledge. Specialists in various fields must rely on information to reach decisions. For this reason, they must be provided with the results of previous work and investigations before they start new programmes. They depend on special libraries to supply them with the information.

The librarian of a special library must be able to provide the information required by the organization's staff. To do this job well, the librarian must (1) be thoroughly familiar with the operation and needs of the organization, (2) know the contents of the library in great detail, and (3) know where to turn for information if the library cannot provide needed information. Even the collections of the largest special libraries have limitations. Therefore, special librarians make extensive use of public, college, university, and research libraries; other special libraries; trade associations; government agencies; and other sources of information.

Many special librarians have training in both librarianship and a special subject. For example, the librarian of an art museum might have degrees in both art history and library science. Similarly, the librarian of a chemical company might have degrees in chemistry and in library science.

Special librarians are organized into an association called the Special Libraries Association. This association has about 11,500 members in several countries. It is divided into various divisions, such as Insurance, and Advertising and Marketing. The divisions enable people with similar interests to work together on common library problems.

Copyright or legal deposit libraries. Most national libraries fulfil a special role in serving as copyright or legal deposit libraries. This type of library is one that can request at least one copy of every book, journal, or periodical published within the country concerned. For example, the British Library in London receives one copy of every book, journal, or periodical published in the

United Kingdom. Other copyright libraries throughout the world include the National Library of Scotland, Edinburgh; the National Library of Wales, Aberystwyth, Dyfed (with some restrictions); the Bodleian Library, Oxford; the University Library, Cambridge; the library of Trinity College, Dublin, in the Republic of Ireland; and the Bibliothèque Nationale, Paris, France.

In the United States, the leading copyright library is the Library of Congress, in Washington, D.C. In Australia, the National Library of Australia, in Canberra, receives one copy of every book or journal published in Australia, and the National Library of New Zealand, in Wellington, is also entitled to receive a copy of every publication appearing in New Zealand. The National Library of India (formerly the Imperial Library) is located in Calcutta and is that nation's copyright library.

Information science

Librarians draw on many fields of knowledge other than library science to help them in their work. One such field, called *information science,* deals with what information is and how people use it. Information science also involves the ways computers, microphotography, and other technological developments can help provide people with information. Librarians study information science to learn how to operate a library so that patrons can get information quickly and easily.

Information science brings together ideas from many other fields, including communications, computer technology, information theory, linguistics, management, mathematics, and psychology and other behavioural sciences. A few examples can help give an idea of how this wide variety of knowledge contributes to the operation of a library. Communications provides an understanding of the various media libraries can use to transmit information. Computer technology helps librarians design automated library procedures. Information theory, a branch of science and engineering, can be used to analyse the quality and characteristics of systems involving the transmission and use of information. Management supplies techniques for analysing and improving library operations. Mathematics provides a means to formulate exact statements of library problems, and linguistics helps in the creation of indexes. Psychology and other behavioural sciences help librarians understand how the human mind reacts when faced with such problems as finding information in a library.

Information science has developed gradually during the 1900's. Today, many colleges recognize its importance and offer courses related to the field. Some colleges and universities offer degrees in information transfer, and some have the words *information science* or *information studies* in their name. Other colleges teach information science as part of engineering.

Many people who complete academic information science courses hold research positions on large public, special, college or university library staffs. Other information scientists may design or manage automated systems for the cataloguing and retrieval of information in books, journals, and other media. Still others work in colleges or universities as information science teachers and researchers.

Libraries of the world

Western Europe has many of the largest, oldest, and most important libraries in the world. The national libraries of Great Britain and France—the British Library in London and the Bibliothèque Nationale in Paris—are world centres of scholarship. The British Library owns about 18 million volumes, and the Bibliothèque Nationale owns about 9 million.

In addition to national libraries, Western Europe has dozens of world-famous university libraries, including those of Oxford University and Cambridge University in England, and of the University of Paris. There are also many important special libraries in Western Europe. Several of them are noted for collections of early manuscripts and books. Vatican Library in Vatican City, the central library of the Roman Catholic Church, is one such institution. Government libraries and libraries of industrial and research organizations operate throughout Western Europe.

Great Britain's public library system became well established during the late 1800's. But in most of the rest of Western Europe, public library systems did not develop until after the end of World War II in 1945. Today, there are good public library systems throughout Britain and Ireland, and Scandinavia. Many librarians consider Denmark's public library system a model for the rest of the world. Much progress is being made toward improving the public library systems of France and other West European nations.

The development of library education in Western Europe has followed roughly the same pattern as the development of public libraries. Excellent library schools operate in France, Germany, Great Britain, and the Scandinavian countries. All except the smallest Western European nations have library associations and publish library journals.

Eastern Europe and Russia. The countries of Eastern Europe have a long tradition of scholarly libraries. The libraries of Charles University in Prague, Czechoslovakia, and of Jagiellonian University in Kraków, Poland, rank among the oldest in Europe. Both date from the 1300's. Each country of Eastern Europe has a national library. The Czechoslovak State Library in Prague has about 5 million volumes. The Hungarian national library in Budapest has more than 2 million.

Libraries have traditionally played an important role in the educational system of the East European nations and of Russia. The governments of these countries have set up public libraries and reading rooms in large cities, small towns, and rural villages. Trade unions and workers' councils in industry also maintain their own library systems. Public, trade union, and workers' libraries total about 25,000 in Poland, 20,000 in Czechoslovakia, 6,800 in Romania, 6,500 in Bulgaria, and 9,200 in Hungary.

Libraries in Russia and the other countries that formerly made up the Soviet Union total about 330,000. About 130,000 of them are public libraries. The Russian State Library (formerly the Lenin Library) in Moscow is Russia's largest library and one of the largest in the world. Its collections of books, magazines, and newspapers include about 28 million items. The Library of the

The Russian State Library, in the heart of Moscow, is the largest library in Russia and one of the largest in the world. This ornately decorated library houses about 28 million items. It serves both as Moscow's main public library and as a national centre for scholarship.

Academy of Sciences in St. Petersburg has about 13 million volumes. The M. E. Saltykov-Shchedrin State Public Library, also in St. Petersburg, houses more than 21 million volumes.

Russia and the countries of Eastern Europe have library associations that oversee standards for the countries concerned. They also have journals and programmes for the education of librarians.

The Middle East does not have many well-supported modern libraries. The largest library in the Middle East is the Jewish National and University Library in Jerusalem, Israel. Its collection totals more than 2 million volumes. Other relatively large libraries in the Middle East include the national libraries of Turkey and Lebanon; the University of Teheran in Teheran, Iran; and the University of Ankara in Ankara, Turkey. Saudi Arabia has four university libraries. Egypt, which is part of both the Middle East and Africa, has large national and university libraries (for more information, see the *Africa* section of this article).

Public libraries are scarce throughout most of the Middle East. The most modern ones are in Jerusalem and Tel Aviv, Israel. Library education programmes are offered at the Hebrew University, the University of Teheran, and the University of Ankara. Library associations have been established in Egypt, Iran, Iraq, Israel, Lebanon, and Turkey.

Africa. Millions of Africans have no public library service. In some African nations, the only important libraries are those connected with institutions of higher education. Some countries do not have any locally supported public libraries.

The lack of library service is most serious in the more than 30 nations that became independent during the 1950's and 1960's. Some of these countries have made good beginnings, however. They include Ghana, Ivory Coast, Kenya, Nigeria, Sierra Leone, Tanzania, Tunisia, and Zaire.

Most of the largest and more important libraries are in far northern or southern Africa. The Egyptian National Library in Cairo has over 1½ million volumes, and the Cairo University Library has more than a million. Algeria has a 600,000-volume university library and a large national library that was rebuilt after a fire in 1962. The National Library of Tunisia has more than 500,000 volumes. The Republic of South Africa has several large libraries. They include the Johannesburg Public Library, with about 1½ million volumes; the Cape Town City Library, with about 1 million volumes; and the South African Library in Cape Town, with about 530,000 volumes. The libraries of the universities of Cape Town, Pretoria, and Witwatersrand house from 500,000 to 700,000 volumes each.

Africa has a few programmes for educating librarians. These programmes include those at the universities of Cape Town; Pretoria; Cairo; Ghana, in Accra, Ghana; Ibadan, in Ibadan, Nigeria; Ahmadu Bello, in Zaria, Nigeria; Kano, Nigeria; Maidugan, Nigeria; Dakar, in Dakar, Senegal; and Makerere, in Kampala, Uganda. Africa also has a number of library associations. Among them are the associations that are located in Egypt, Ghana, Nigeria, South Africa, Tanzania, Togo, and Tunisia.

South and Southeast Asia. Most countries of South and Southeast Asia have national libraries, and one or more university libraries. Most of the libraries are small and poorly supported. The chief national libraries are those of the Philippines, Malaysia, India, Singapore, and Thailand. The largest and best-developed university libraries are at the University of the Philippines; the University of Singapore; and the Indian universities of Allahabad, Bombay, Calcutta, Delhi, and Vadodara, and Varanasi Hindu University. Most of the countries of South and Southeast Asia have scientific and commercial libraries, and many major government branches operate libraries.

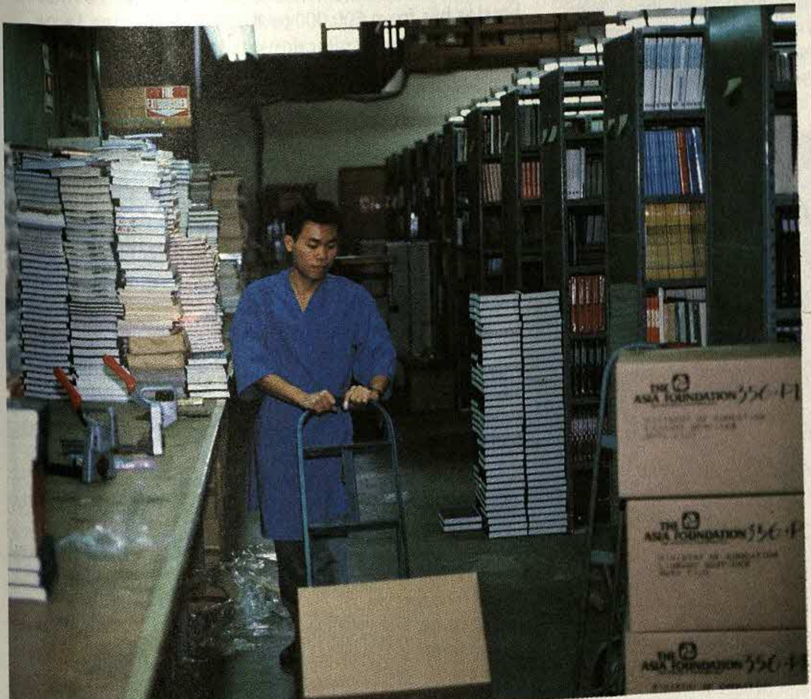
Most of the free public libraries in South and Southeast Asia have been constructed since the end of World War II, but many countries in the region have made little progress. One of the largest libraries in South and Southeast Asia is the Delhi Public Library in India. It has about 630,000 volumes. This library was founded in 1951 with the assistance of the United Nations Educational, Scientific and Cultural Organization (UNESCO) to demonstrate what a modern public library should be like.

Training programmes for librarians are offered in many parts of South and Southeast Asia. They include those of Chulalongkorn University in Bangkok, Thailand; the University of the Philippines in Quezon City; the universities of Delhi and Madras in India; and the University of Karachi in Pakistan. Library associations operate in many of the countries of South and Southeast Asia.

Australia and the Far East. The National Library of Australia, in Canberra, has more than 1 $\frac{1}{2}$ million volumes. The country's largest university library is that of the University of Sydney. It has more than 2 million volumes. Each state has a state library in its capital. The largest is the State Library of New South Wales in Sydney, with about 1 $\frac{1}{2}$ million volumes. Australia has many governmental libraries, and others that serve commercial, research, and industrial organizations. Almost every city and town has public and school libraries. Australia has a library association, a professional library journal, and several library schools.

Japan also has a well-developed library system. The National Diet Library in Tokyo owns more than 7 million volumes. It has about 30 branches. There are nearly 400 Japanese university libraries. The most important ones are the libraries of the universities of Tokyo and Kyoto, each of which has about 4 million volumes; Tohoku, Hokkaido, and Kyushu universities, each with over 1 $\frac{1}{2}$ million volumes; and Kobe and Waseda universities, each with about 900,000 volumes. Some public and school libraries operate in Japan. In some areas, mobile libraries provide library services to factories.

Many Japanese universities offer library education programmes, including the Japan Library School at Keio



Books for Asia is a library development programme sponsored by the Asia Foundation. It has provided more than 24 million books and journals to over 30,000 institutions in 28 Asian countries. At the Books for Asia Center in San Francisco, *left,* the books are prepared for shipment.

University in Tokyo. Japan has several library associations and a professional library journal.

In spite of a trend toward increased contact between China and the rest of the world over the years, there is still a shortage of reliable information about the library system of China. The great National Library in Beijing reportedly has more than 10 million volumes, and the Nanjing Library owns about 4,700,000 volumes. Each province has at least one central library, with collections ranging from 100,000 to 3,500,000 volumes. Since 1949, when the Communists conquered China, dozens of universities, colleges, and technical institutes have been founded, all with libraries. The Communists have made efforts to bring books and libraries to the people through schools, factories, and some public libraries. The municipal library of Shanghai is reported to have several branches containing about 6,900,000 volumes.

The other countries of the Far East have lagged behind in library development. The largest library of Taiwan is that of the National Taiwan University, which has about 1,200,000 volumes. South Korea has the 700,000-volume Central National Library, the million-volume Seoul National University Library, and the 400,000-volume Korea University Library, all in Seoul. Both Taiwan and South Korea have library schools and professional associations for librarians. The $1\frac{1}{2}$ million-volume State Central Library in Pyongyang is the largest library in North Korea.

North America. The chief library in the United States is the Library of Congress, in Washington, D.C. This is probably the largest national library in the world. For more information, see the article **Library of Congress.** The Library of Congress is one of nearly 3,000 government libraries, both federal and state, that operate all over the United States. Federal libraries are administered by the central government or government agencies. For example, the National Agricultural Library, with over $1\frac{1}{2}$ million items, serves the U.S. government's agricultural department. State libraries are run by the individual states themselves. Research libraries include the National Library of Medicine, which has more than $2\frac{1}{2}$ million items. One of the most interesting specialist libraries is the 225,000-volume Folger Shakespeare Library, in Washington, D.C. See **Folger Shakespeare Library.** The American Library Association, which aims to promote the highest standards of library organization, service, and librarianship, has more than 40,000 members and is based in Chicago, Illinois.

The library of the Museum of Anthropology in Mexico City, *above,* owns many ancient manuscripts. This student is studying a manuscript to learn about early Mexican Indian culture.

The largest university library system in the United States and in the world is that of Harvard University. Its collections include more than 11 million books and pamphlets and numerous charts, maps, manuscripts, and microfilms. The Office of Publications Exchange of the Smithsonian Institute, in Washington, D.C., is the official U.S. agency for the international exchange of scientific and scholarly publications.

In Canada, the National Library of Canada, based in Ottawa, contains about 80,000 volumes. It opened in 1953. The older Library of Parliament, also in Ottawa, opened in 1867. It contains some 570,000 volumes and is used mainly by politicians drafting laws. The 4,500-member Canadian Library Association, dedicated to the promotion of high standards in librarianship and library and information services, has its headquarters in Ottawa.

Latin America. Libraries and librarianship have had a difficult time gaining recognition and support in most of Latin America. The major emphasis there has been on building national libraries and libraries for universities and other educational institutions. The most important national libraries of Latin America include those of Argentina, Brazil, Chile, Mexico, and Peru. Each of these libraries has from 600,000 to 1,800,000 volumes. Large university library collections include those of the University of Buenos Aires and the University of Chile. Each collection has more than a million volumes, which are distributed among several branch libraries.

Many cities and towns in Latin America have no free public library service, but several countries are making important gains toward that goal. Brazil has developed some of the best public libraries in Latin America. The São Paulo Municipal Library is especially noteworthy. Other Latin-American countries that have made advances in providing public library service are Argentina, Chile, Colombia, Panama, and Peru.

Most Latin-American countries have special schools to train librarians. These countries include Brazil, which has about 30 library schools, and Argentina, Chile, and Colombia. Almost all Latin-American countries have national library associations.

International library programmes. Several international and national organizations work to improve libraries throughout the world, especially in developing countries. UNESCO and UNICEF—agencies of the United Nations—have done much to upgrade libraries in developing nations.

The many UNESCO library activities have included the establishment of model public libraries in developing countries. UNESCO has also done much to aid the formation of library schools and sponsor training programmes and seminars in countries lacking such resources. UNICEF's many activities have included the provision of books to schools in less wealthy countries. Many developed countries, including France, Germany, the United Kingdom, and the United States, have aid agencies that help upgrade libraries in developing nations. Government agencies such as the British Council and the United States Information Service maintain libraries in many countries around the world and run support and training programmes for librarians in these countries.

The International Federation of Library Associations and Institutions (IFLA) was founded in 1927 to promote international library cooperation. The IFLA has about 1,000 members and affiliates, representing about 110 countries. The IFLA meets annually and has done much to unify library procedures and standards and to promote understanding among the librarians of the world. The IFLA has headquarters in the Netherlands and publishes the quarterly *IFLA Journal.*

Several international associations promote cooperation among libraries that specialize in the same field. They include associations of law, music, and school libraries.

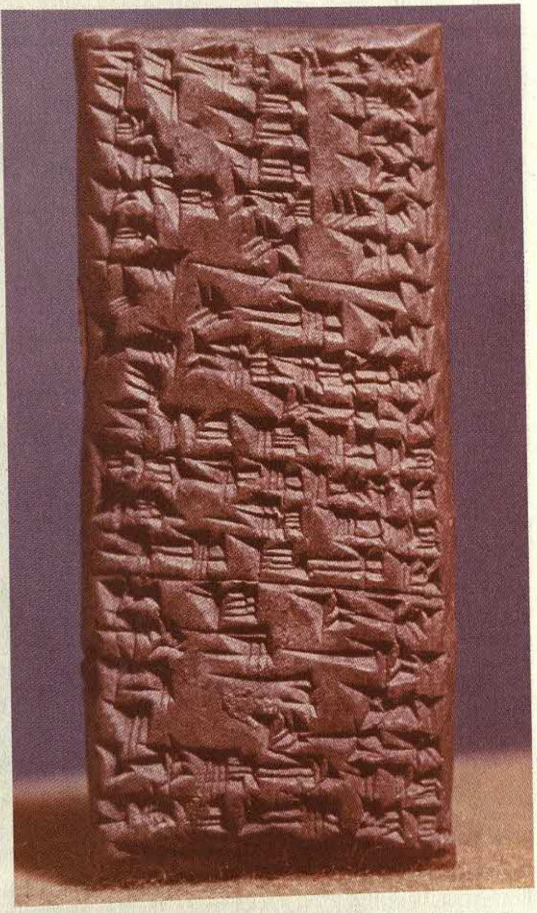
A number of private foundations help the international development of libraries. For example, the American-sponsored Asia Foundation has worked to develop libraries in 17 Asian countries. The Ford Foundation has given financial support to develop libraries in Asia, Africa, and Latin America. Other foundations that give financial support to libraries of various nations include the China Medical Board of New York and the Gulbenkian Foundation.

History

The history of libraries parallels the history of writing. For about 5,500 years, people have made written records of their ideas, their relations with others, and the world around them. They have kept their records on a variety of materials—bone, clay, metal, wax, wood, papyrus, silk, leather, parchment, paper, film, plastic, and magnetic tape. At almost every stage in the development of these materials, people have assembled collections of their records into libraries.

Libraries of clay were established in ancient Mesopotamia, a region that now covers part of Iraq, Syria, and Turkey. The peoples of Mesopotamia discovered that lasting records could be made by making marks on wet clay, which was then dried or baked. Thousands of these clay tablets still exist, but scholars have not yet learned the meaning of the markings on all of them.

Some of the oldest clay tablets discovered were made more than 3,000 years before the birth of Christ by the Sumerians, a people who lived in southern Mesopotamia. A library of 30,000 clay tablets has been found at the site of the ancient city of Nippur (see **Sumer**). Archaeologists have found other libraries of clay tablets in excavations of ancient cities in Syria and Turkey.



A clay tablet of the 600's B.C. lists literary works, probably for use in the Royal Library at Nineveh in Babylonia. The Mesopotamians collected thousands of such tablets for huge libraries.

In 1850, British archaeologists discovered thousands of clay tablets at the site of Nineveh. Nineveh was the capital of ancient Assyria, which occupied northern Mesopotamia. The tablets formed part of a library in the palace of King Sennacherib of Assyria, who ruled from 704 to 681 B.C. In 1853, an even larger library was found nearby. This collection had been assembled by Sennacherib's grandson, Ashurbanipal. Ashurbanipal brought together a huge collection of records from earlier kingdoms and empires. See **Assyria** (Language and literature).

Libraries of papyrus. During the period that the peoples of Mesopotamia were writing on clay, the Egyptians were using *papyrus,* a writing material made from the papyrus reed. This reed grew in the marshlands of the Nile River. The Egyptians cut its stems into strips, pressed the strips into sheets, and joined the sheets to form scrolls. Some of the scrolls reached great length. One, called *Harris Papyrus 1,* is 41 metres long. This scroll is in the British Library.

Papyrus is extremely perishable. Even so, some ancient writings on papyrus have survived. The oldest ones date from about 2700 B.C. *Harris Papyrus 1* dates from the 1100's B.C.

Papyrus became the preferred writing material among peoples of the Mediterranean area about 500

Detail of a German engraving (1800's)

The Alexandrian Library in Alexandria, Egypt, was the most famous library of the ancient world. It had a copy of every existing scroll known to the library's administrators.

B.C., and it remained so until about A.D. 300. The Egyptians used it until the 900's. See **Papyrus; Manuscript** (Papyrus manuscripts).

The great libraries of ancient Egypt, Greece, and Rome all consisted of collections of papyrus scrolls. These libraries disappeared, and most of what we know about them is based on second-hand reports. For example, scholars have found references to Egyptian libraries at Amarna in the 1300's B.C., and at Thebes in the 1200's B.C. But the libraries themselves are gone.

Egypt. The most famous library of ancient times was the Alexandrian Library, a Greek institution of the Hellenistic Age. It was located in Alexandria, Egypt. Alexander the Great founded Alexandria in the 330's B.C. His successors as ruler of Egypt, Ptolemy I and Ptolemy II, developed the Alexandrian Library into the greatest collection of scrolls in the ancient world. The Ptolemies borrowed books from libraries in Athens and other cities and had them copied. According to legend, Ptolemy II shut 72 Jewish scholars in cells on the island of Pharos until they produced the *Septuagint,* the first known Greek translation of the Hebrew Old Testament.

The Alexandrian Library had a copy of every existing scroll known to the library's administrators. It owned more than 400,000 scrolls. A succession of famous scholars headed this library, which became renowned for the scholarly studies it supported as well as for its collection. Not a trace of the library remains today, and no one knows for certain what became of it.

Greece. The Greeks also used papyrus. Some historians credit Pisistratus, a ruler of Athens during the 500's B.C., with establishing that city's first government-owned library. Most people of ancient times could not read, and so "public" libraries—like that of Pisistratus—served only a small minority of the population.

The most famous library of ancient Greece was founded by the philosopher Aristotle at his school at the Lyceum. It served the same purpose as a university library today. The library no longer exists. According to one tradition, Aristotle's successors sold its collection to the Alexandrian Library. Another account says Lucius Cornelius Sulla, a Roman general who sacked Athens, took the collection to his palace in Rome.

Rome. The ancient Romans continued the library-founding tradition of the Egyptians and Greeks. The earliest Roman libraries were personal collections. Greek literature, which the Romans admired, formed the main part of these collections. The possession of a personal library became a status symbol in Rome, and satirical writers often mocked the practice.

The Roman soldier-statesman Julius Caesar made plans for a public library in Rome. The Octavian Library probably resulted from his plans. Emperor Augustus built this library on Rome's Palatine Hill in 37 B.C., seven years after Caesar's death. The Octavian Library may have been Rome's first public library. Many other public libraries were built soon after. A survey of Rome's important buildings in A.D. 337 included 28 libraries. The best of these was the Ulpian Library, built about A.D. 110 by Emperor Trajan. It had separate buildings for storing Greek and Latin books.

The Romans encouraged the establishment of libraries throughout their huge empire. Some of the buildings that resulted still stand. They include Hadrian's Library, which was built by Emperor Hadrian at the foot of the Acropolis in Athens about A.D. 125.

The great collections of the papyrus libraries of the Roman Empire disappeared, like those of ancient Egypt and Greece. But one collection, which belonged to a Roman nobleman named Lucius Calpurnius Piso, was recovered. Piso lived in Herculaneum, a town at the foot of Mount Vesuvius, a volcano. In A.D. 79, Vesuvius erupted, and Herculaneum and the nearby towns of Pompeii and Stabiae were buried. In the 1750's, excavators uncovered the library. The papyrus scrolls were still in place. The National Museum in Naples has about 1,800 of the scrolls.

Libraries of animal skins. Scholars of the ancient world wrote on leather—which is made from animal skins—when papyrus was not available. During the 1940's and early 1950's, hundreds of manuscripts, chiefly leather scrolls, were found in caves near the shore of the Dead Sea. These *Dead Sea Scrolls,* as they are called, probably belonged to the library of a Jewish religious group called the *Essenes.* The Essenes lived in the highlands near the Dead Sea from about 150 B.C. to A.D. 68. One of the main activities of the group's members was the copying of religious texts. The Dead Sea Scrolls include the oldest known manuscripts of the Bible. See **Dead Sea Scrolls.**

Parchment, made from thin layers of animal skin, was a great improvement over leather. According to legend, parchment came into wide use because of the rivalry between the library in Alexandria and the library of Pergamum, a city in what is now Turkey. When Pergamum's library threatened to become better than Alexandria's, the Egyptians cut off the supply of papyrus to Pergamum. So the people of Pergamum developed parchment as a substitute. The word *parchment* comes from *Pergamum.*

Parchment sheets cannot be satisfactorily joined into rolls, as can sheets of papyrus. Therefore, scribes and librarians developed the practice of folding several sheets of parchment down the middle and sewing them together through the fold. This practice established the form that books have taken ever since. By the time the West Roman Empire ended in A.D. 476, parchment had largely replaced papyrus in Europe.

The Middle Ages. In A.D. 378, when the Roman Empire was declining, the historian Ammianus Marcellinus complained that "The libraries are closing forever, like tombs." His statement reflected part of a decline in all forms of education that was taking place in Europe.

In 476, the West Roman Empire ended and the period known as the *Middle Ages* began. This period lasted until the 1400's. During the first half of the Middle Ages—until about the late 900's—educational and artistic activity sank to a low level in Europe. Such activity took place in relatively few places in the Western world.

Chief among the places where education flourished was Constantinople (now Istanbul, Turkey), the capital of the Byzantine, or East Roman, Empire. The learning and cultural activity that continued there provided a link between ancient and modern European civilizations. During the 500's in Constantinople, for example, a group of legal scholars used library materials and other resources to produce the Justinian Code. This collection of Roman laws ranks among the most important legal documents of all time. It became the foundation for the legal systems of many countries today. Also in Constantinople, during the 900's, the encyclopedic work known as *Suidas* recorded much knowledge that would otherwise have been lost. The crusaders sacked Constantinople in 1205. After the Turks took over Constantinople in 1453, the city's libraries disappeared.

Christian monasteries made another major contribution to the preservation of libraries and learning during the early Middle Ages. The copying of manuscripts became a major activity of the monks who lived in monasteries throughout Europe and in parts of Asia and Africa. The monks worked in a room called a *scriptorium.* Most of the manuscripts they copied were from religious works, especially the Bible. But they also copied other works, including writings from ancient Greece and

Detail of a French manuscript (1300's); Bibliothèque Nationale, Paris

A monk in a scriptorium copies a manuscript by hand. Such laborious work by medieval Christian monks helped preserve writings of ancient times for libraries of today.

Rome. The monks sold some of the copies they made and kept others in the monastery libraries.

One of the oldest copies of the Bible was found in St. Catherine's monastery, on the Sinai Peninsula at the western tip of Asia. This manuscript, called *Codex Sinaiticus,* dates from the early 300's. It was found in 1844 and is now in the British Library. Other important texts were found in the libraries of Greek monasteries on Mount Athos and of Coptic monasteries in Egypt. In Bethlehem, from 386 to 420, St. Jerome produced a large body of sacred writings. These works included his famous Latin translation of the Bible, called the *Vulgate.*

About 540, Cassiodorus, a Roman nobleman, established a monastery on his estate in southern Italy. The monastery was devoted to the making of books that were both religious and nonreligious. Cassiodorus has been called the *father of literary monasticism in the West.* Many other monasteries also gained importance for their scriptoriums and libraries. Ireland contributed much to the movement. Irish monks produced many books, and the monks also founded monasteries in other parts of Europe.

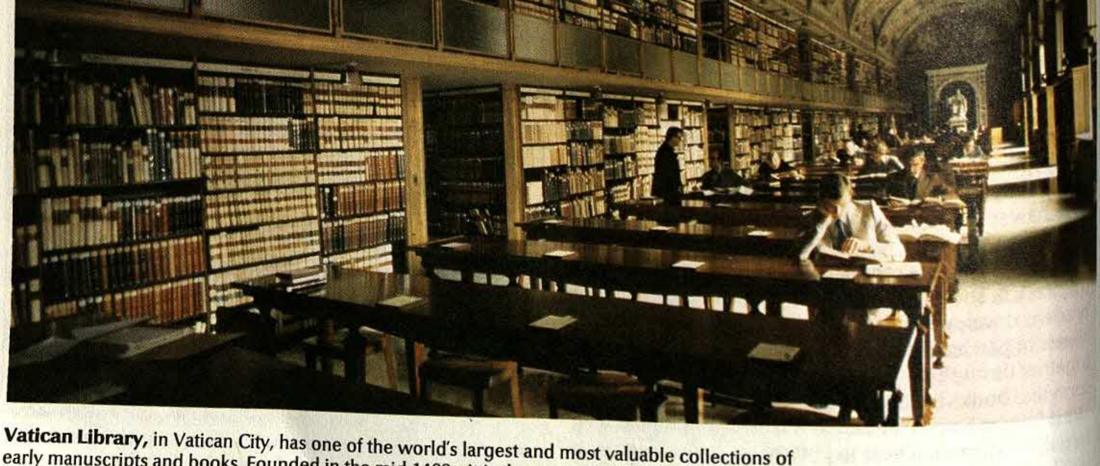
The modern university began to develop in Europe during the 1100's. Instruction and discussion, rather than research, were the main features of the earliest universities. But research gained importance through the years, and the universities gradually amassed great library resources.

The growth of the universities reflected Europe's emergence from the Middle Ages and entry into the Renaissance, which began in Italy about 1300. Europeans acquired a great desire for art and learning and looked back to ancient Greece and Rome for inspiration. Scholars found and translated ancient writings, and writers created literatures of their own.

The renewed interest in learning led many aristocrats to develop private libraries. One such private collection was begun by Cosimo de' Medici in Florence, Italy, during the 1400's. It formed the basis of the Laurentian Library, which ranks among the world's finest libraries today. The famous artist Michelangelo designed its building. In England, Humphrey, Duke of Gloucester, accumulated a large and valuable collection of writings. He gave it to Oxford University in the early 1400's. The university's library still has some of the writings. The Vatican Library also dates from the 1400's. This library of the Roman Catholic Church houses many items of the world's most valuable literary treasures. See **Vatican Library.**

The East. The Chinese developed a deep respect for scholars and scholarship far back in ancient times. Ancient Chinese libraries were established for use by scholars, royalty, and aristocrats. The libraries helped advance and preserve Chinese learning. This learning became a major influence in China and other countries of the East. The East did not experience a decline in learning during the Middle Ages, as did the West. But libraries and other educational tools were used only by scholars and the upper class until the 1900's.

Paper, printing, and libraries. The Chinese had invented paper in A.D. 105. Paper is better suited for the manufacture of books than is any other material. The art of papermaking reached Baghdad (now in Iraq) by 800, Egypt by 900, and Europe by 1100. The use of paper



Vatican Library, in Vatican City, has one of the world's largest and most valuable collections of early manuscripts and books. Founded in the mid-1400s, it is the central library of the Roman Catholic Church. Scholars from all parts of the world are permitted to use the library.

grew rapidly in Europe, and, by 1500, paper had almost completely replaced parchment.

During the Renaissance in Europe, the spread of education and the increasing desire for knowledge created a demand for books which greatly exceeded the supply that could be created by hand copying. The problem was solved by the invention of printing from movable type, which had been known for centuries in Asia but was not discovered by Europeans until the 1400's. Johannes Gutenberg of Germany is credited with the invention of movable type in Europe. Gutenberg began printing books in the mid-1400's, and his technique spread rapidly. See **Gutenberg, Johannes.**

Printing on paper revolutionized bookmaking. More and more books could be printed, and more and more persons could afford to buy them. The printed book also brought many changes in libraries. Books gradually replaced handwritten manuscripts. The books were put on open shelves, not in chests, as the manuscripts had been. The Vatican Library, founded at this time, was one of the first libraries to have shelves. By 1600, libraries had started to look like present-day libraries. Shelves of books lined the walls, and tables for readers stood in the middle of the room.

Famous libraries. The 1600's were a golden age for libraries. Many great libraries that still exist opened in Europe, a number of them in universities. The first state-supported libraries were also founded.

Great Britain. Duke Humphrey's library at Oxford was almost completely destroyed in the mid-1500's, when the government sought to wipe out all traces of Roman Catholicism. Sir Thomas Bodley, an English statesman, began to rebuild the library in the late 1500's. It was renamed the Bodleian Library. This library grew through the years, and today it ranks as Great Britain's second largest. See **Bodleian Library.**

In 1759, Great Britain opened the British Museum, which included a museum and a national library. The library, which became the British Library in 1973, is the nation's largest and contains many priceless treasures. See **British Library.**

The public library tradition in Great Britain has been strong since the late 1800's. But traces of it date back hundreds of years. The first known public library in the British Isles began in the Guildhall in London in 1425. The second began in Edinburgh, Scotland, in 1580. These libraries no longer exist. The first continuing library that was open to the public was founded in Manchester, England, in 1653. Parliament passed the Public Libraries Act in 1850, and public libraries gradually spread throughout Britain.

France. The national library of France, the Bibliothèque Nationale in Paris, began in 1367 as the Royal Library of King Charles V. During the French Revolution (1789-1799), the Royal Library became the Bibliothèque Nationale. The Bibliothèque Nationale ranks among the largest and most important libraries in the world. See **Bibliothèque Nationale.**

In 1643, Jules Cardinal Mazarin founded the great Mazarine Library in Paris. He collected books and manuscripts from all parts of Europe and opened the library to the public. The library is also famous for its influence on the methods of operating libraries. Cardinal Mazarin's librarian, Gabriel Naudé, wrote one of the first treatises on library management. Librarians consider much of what Naudé wrote as still valid today. The French government now owns the Mazarine Library.

Italy. The great libraries of Italy include the Laurentian Library in Florence, the Vatican Library in Vatican City, the Ambrosian Library in Milan, and the National Central Library in Florence. The Laurentian and Vatican libraries are described in *The Middle Ages* section of this article. The Ambrosian Library, founded in 1609, is noted for its collections of monastic, Oriental, and scientific manuscripts. The National Central Library collection is based on that of Antonio Magliabecchi, a famous book collector and bibliographer.

Germany. Before World War II began in 1939, the national library of Germany was in Berlin. It was founded in 1661 by Frederick William, ruler of the state of Brandenburg. The library became, in turn, the Royal Library, the Prussian State Library, and the German State Library. It suffered heavy damage during World War II.

Russia. The M. E. Saltykov-Shchedrin State Public Library in St. Petersburg has been one of Russia's most prestigious libraries since it was founded in the late 1700's by Empress Catherine the Great. The Russian State Library in Moscow was founded by Count Nikolai Rumyantsev in 1861.

Other European libraries. The Royal Library of Denmark in Copenhagen was established in 1657. King Philip V founded the National Library of Spain in Madrid in 1711. In Portugal, the National Library in Lisbon dates from 1796. National libraries, as well as great university libraries, were founded in many other European countries during the 1600's and the 1700's.

Latin America. Spanish *conquistadors* (conquerors), priests, and colonists brought the first large collections of books to Latin America during the 1500's and 1600's. Latin America's oldest libraries are university libraries. The University of Santo Domingo in the Dominican Republic was founded in 1538. It is the oldest university in the Western Hemisphere. The National Autonomous University of Mexico in Mexico City and the University of San Marcos in Lima, Peru, were established in 1551. The libraries of these universities may date from the time the schools were founded.

Latin America's largest national libraries were established in the 1800's. Argentina's national library in Buenos Aires and Brazil's national library in Rio de Janeiro opened in 1810. The national library of Chile was established in Santiago in 1813. Mexico's national library dates from 1833.

The United States. The Harvard University Library, the oldest U.S. library, was founded in 1638. The first free lending libraries in the American colonies were founded by Thomas Bray, an English clergyman, in Maryland during the late 1600's. Interest in these libraries disappeared, however, after Bray's death. In 1731, Benjamin Franklin and his friends founded the first subscription library in America, the Library Company of Philadelphia. The success of the company led to the founding of many other subscription libraries in the American Colonies.

The National Library of Australia is sited in Canberra, the nation's capital city. The National Library was established in 1960. It has more than 1½ million books.

In 1815, Congress bought Jefferson's collection for the Library of Congress, which had been burned during the War of 1812. The Library of Congress was redeveloped around Jefferson's books.

A strong movement to develop free public libraries began in the early 19th century and spread rapidly. In 1846 the Smithsonian Institute was founded in Washington, D.C. Its early projects reflected the growing interest in libraries throughout the nation. An important current index, *Readers' Guide to Periodical Literature,* had its beginning with the index developed by the first librarian of Chicago Public Library, William Poole. Poole's Index to Periodical Literature was first published in 1882 at the request of the American Library Association.

An important name in librarianship worldwide is that of Melvil Dewey. He was a major figure in the history of libraries. He helped to found the American Library Association. He started the periodical *Library Journal* and he developed the Dewey Decimal Classification System which is used in many countries.

Canada. Library development in Canada has largely paralleled that in the United States. Canada's first college library was established in 1635 at the Jesuit College of Quebec. The Canadian Library Association was founded in 1946. In 1953, Canada established a national library in Ottawa.

Australia and New Zealand. The first libraries in Australia were subscription libraries, established in the early 1800's. Free public libraries began in most state capitals before the 1880's. The first such public library started in Melbourne in 1853.

Local public libraries developed very slowly. In 1935, the Munn-Pitt Report examined conditions in Australia's public libraries. Acting on the report's recommendations, the Australian central government created a library board in each state to administer state government funds for local library development. Later legislation set up the library councils of Victoria and New South Wales. Official funding for school libraries began in 1969. In 1981 the Australian federal government set up the Australian Libraries Information Council to advise on library needs across the country.

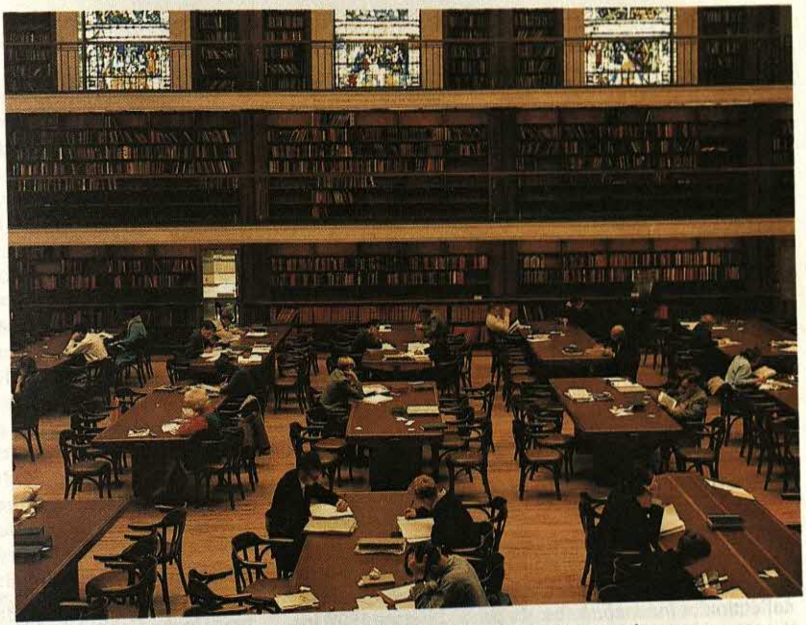
Australia's first university library, now called the Fisher Library, was established by the University of Sydney in 1852. By 1912, the universities of Melbourne, Adelaide, Tasmania, Queensland, and Western Australia all had libraries. The Library of the Commonwealth Parliament, set up in Melbourne in 1901, moved to Canberra in 1927. A separate National Library, sited in Canberra, was established in 1960.

In New Zealand, an act of 1877 provided government subsidies for public subscription libraries. The first such library was set up in 1880 in Auckland under the control of the city council. Following a survey of New Zealand libraries in 1934, most authorities established library collections in which items of permanent interest were lent to users free of charge, while popular books, such as romantic novels, could only be rented. New Zealand's Country Library Service and its School Library Service began before 1942. These services became part of the National Library of New Zealand, which dates from 1966. The National Library also includes the Alexander Turnbull Library, set up in 1918 and now a major reference and research library.

India. The first libraries in India were collections of manuscripts housed in the scriptoriums of medieval Buddhist and Jain monasteries. Modern libraries, however, did not begin to emerge in the Indian peninsula until the 1800's. During this period, printing underwent a rapid growth, and India's modern education system came into existence. University libraries developed, and the National Library of India was founded in Calcutta as the Imperial Library in 1903.

Today India has several hundred libraries, including both university and state libraries. More than one-third of India's population can read and write, and this level of

State libraries in Australia, such as the State Library of New South Wales, have general reference books as well as special collections of material.



literacy has encouraged the rapid growth of the country's publishing industry. State and university libraries are the chief buyers of books produced by native Indian publishers. But for political reasons the financial support given to these libraries by the state has not always been secure. For example, in the late 1970's and early 1980's, the central government of India stopped funding state and university libraries, so they could not buy books.

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Dewey, Melvil
MacLeish, Archibald

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Alexandrian Library
Bibliothèque Nationale
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British Library
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Harvard University Library was founded in 1638.

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Questions

How do today's libraries differ from those of the past?

What challenges and problems do libraries face?
Discuss the role of technology in today's libraries.
Discuss and compare library development around the world.
What did Melvil Dewey and Andrew Carnegie contribute to the development of libraries?
What are the main types of public library and what are their general functions?
How do school librarians serve their communities?
Why is the future development of libraries and librarianship so important?
What services does a state library provide to the state government? To other libraries?
Discuss and compare library development around the world.
What did Melvil Dewey contribute to library development?
How do school librarians serve their communities?
Why is the future of libraries and librarianship so important?

Library of Congress, in Washington D.C., is one of the largest and most valuable research libraries in the world. The Library of Congress has about 84 million items in its collections, including over 20 million books and pamphlets, and millions of charts, engravings, manuscripts, maps, films, musical compositions, photographs, and recordings. The library owns the largest collection of *incunabula* (books printed before 1501) in the Western Hemisphere. This collection has about 5,600 books, including a perfect copy of the Gutenberg Bible, the first important book printed in the Western world.

The library's 35-million-piece manuscript collection represents all aspects of American life and culture. The U.S. history collection contains the papers of almost every president from George Washington to Calvin Coolidge. The library's Chinese, Japanese, and Russian collections are among the largest in the world.

The library's first responsibility is to provide research and reference assistance to the U.S. Congress. But it also serves as the national library, having extended its services over the years to government agencies, other libraries, scholars, and the general public. The librarian of Congress administers the library. The librarian is appointed by the United States president with Senate approval.

The Library of Congress provides cataloguing information to other libraries on printed cards, on magnetic tapes, and in book catalogues. Through a programme called *Cataloging in Publication,* the library gives publishers cataloguing data to be printed directly in books, usually on the back of the title page. The Library of Congress loans other libraries books that are unobtainable elsewhere and supplies photocopies of other materials. The library also provides books in braille and recorded books to blind and handicapped readers. More than 160 cooperating libraries help distribute these materials.

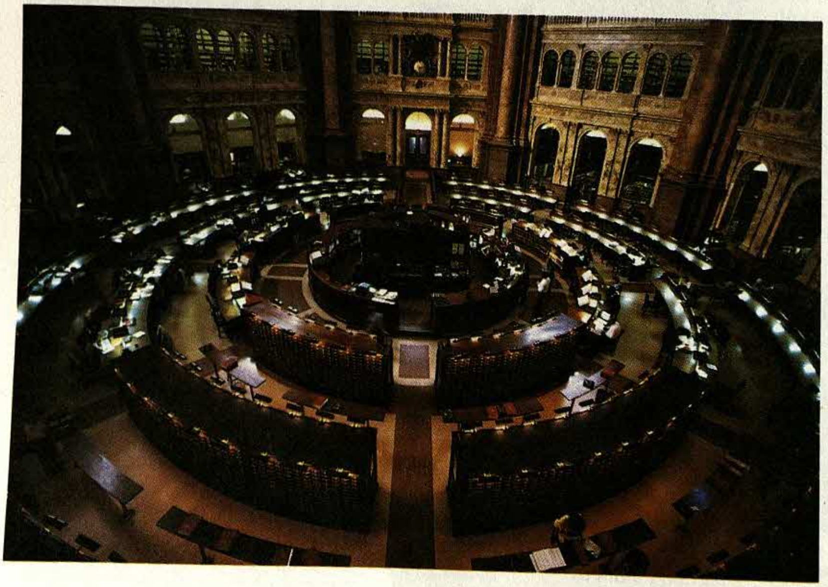
One department of the library administers the copyright laws. Two copies of every publication for which an author requests copyright protection must be deposited in the library. The library selects items for its collections from these deposits.

Congress established the library in 1800. It appropriated 5,000 U.S. dollars to buy books and furnish a room in the Capitol for the library. This first library was destroyed in 1814 when the British burned the Capitol.

Congress immediately began building up a new library in the Capitol. In 1815, it purchased the private library of Thomas Jefferson, which had about 6,000 books. The Library of Congress continued to grow, although several fires—the most serious in 1851—damaged the collections. In 1897, the library moved to a new grey sandstone building east of the Capitol because it was too large to be kept in the Capitol. In 1938, an annex of white Georgia marble was built on an adjoining site. In 1980, the James Madison Memorial Building, the largest library building in the world, was constructed. At this time, the 1897 structure was renamed the Thomas Jefferson Building and the 1938 annex was renamed the John Adams Building. Together, the three library buildings have about 29 hectares of floor space.

See also **Library; Library of Congress Classification; MacLeish, Archibald.**

Library of Congress Classification is a system for arranging materials in a library. Many large research and university libraries use this system. It provides

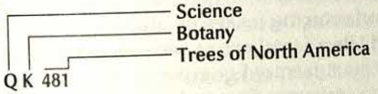


The Main Reading Room of the Library of Congress, *left,* is the centre of the greatest research library in the United States. Scholars from all parts of the world come to study at the library.

greater precision in most fields and more room for expansion than the Dewey Decimal Classification (see **Dewey Decimal Classification**).

Each Library of Congress classification is represented by a set of capital letters and numbers. The first letter in the set indicates one of 21 major areas of knowledge. These areas include: A-General Works; B-Philosophy, Psychology, and Religion; C to F-History; G-Geography, Anthropology, and Recreation; H-Social Sciences; J-Political Science; K-Law; L-Education; M-Music; N-Fine Arts; P-Language and Literature; Q-Science; R-Medicine; S-Agriculture; T-Technology; U-Military Science; V-Naval Science; and Z-Bibliography and Library Science. The second letter stands for a subclassification. The numbers represent a specific topic.

In the following example, the book *Familiar Trees of America,* by William C. Grimm, has the number QK 481. The Q stands for science, the K for botany, and the 481 for trees of North America.



The Library of Congress developed its classification system in the early 1900's for its large collection of books. Specialists add or modify about 6,000 classification numbers yearly to account for current events and new knowledge.

Libretto. See **Opera** (The libretto).

Libreville (pop. 350,000) is the capital and largest city of the central African country of Gabon. Libreville lies in western Gabon on the Gulf of Guinea, an arm of the Atlantic Ocean, and is a major port. For the location of Libreville, see **Gabon** (map).

The city is Gabon's centre of commerce and culture. Factories in Libreville manufacture food products, furniture, timber, and textiles. The city has a variety of educational and research institutions, including the Omar Bongo University, named after Gabon's president.

Libreville—the name means *free town*—was founded by French naval officers in 1849 as a refuge for freed slaves. In 1883, it became the capital of Gabon, a French colony at that time. It remained the capital after Gabon became independent in 1960. Since the mid-1970's, a convention centre and many other buildings have been erected, and urban renewal has modernized the city.

Libya is an Arab country in northern Africa. It lies on the coast of the Mediterranean Sea. The country is bordered by Egypt and Sudan on the east, Chad and Niger on the south, and Algeria and Tunisia on the west. Tripoli is Libya's capital and largest city. For Libya's total population, see the *Facts in brief* table with this article.

The vast, dry Sahara covers most of Libya, and the country has few natural resources. But the discovery of petroleum in 1959 injected huge sums of money into Libya's economy. The government of Libya used some of this wealth to improve farmland and public services.

Almost all of Libya's people are of mixed Arab and Berber ancestry and are Muslims. Until the early 1900's, Libya consisted of three separate geographical and historical regions. It became a united, independent country in 1951. Libya's official name is the Great Socialist People's Libyan Arab Jamahiriya.

Government

Muammar Muhammad al-Qadhafi is Libya's head of state, but he holds no official title. In 1969, Qadhafi led a military revolt that overthrew the ruling monarchy.

Libya's government is based on popular assemblies. All Libyan citizens age 18 or older may vote and hold office. About 1,000 local groups elect a representative to the General People's Congress (GPC), which officially runs the national government. The GPC meets every year to consider legislation and to select the members of the policy-making General People's Committee.

Libya is divided into 24 political units called *baldiyas.* A local People's Congress administers each baldiya. Political parties have not been permitted since 1952. In 1971, the Arab Socialist Union was formed as Libya's only political alliance. But a number of underground opposition groups exist, both in Libya and other countries.

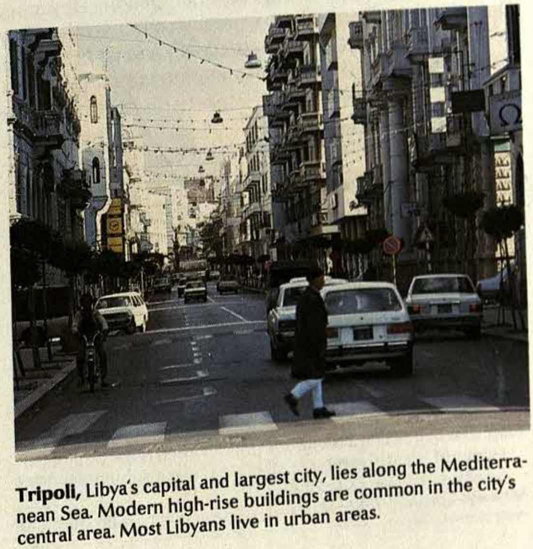
People

Population and ancestry. About 80 per cent of Libyans live along the Mediterranean coast or in the upland regions just south of the coast. More than 90 per cent of the population is of mixed Arab and Berber ancestry. The Berbers lived in Libya before the Arabs arrived in the A.D. 600's.

Languages. Arabic is the official language of Libya, and it is spoken by almost all the people. But many educated Libyans speak a second language, particularly English or Italian.

Way of life. About 70 per cent of Libya's people live in urban areas. About 30 per cent live in rural areas, mostly in villages or desert oases. Some nomads move with their sheep, goats, and camels in search of pasture.

Since the mid-1900's, the expansion of the Libyan economy has brought about a substantial migration from rural areas to the cities. The transition from rural to urban life has required many difficult adjustments to traditional ways of life. For example, rural Libyans live as an extended family, with several generations sharing a single home. But this arrangement is not practical in Libya's crowded cities.



Tripoli, Libya's capital and largest city, lies along the Mediterranean Sea. Modern high-rise buildings are common in the city's central area. Most Libyans live in urban areas.

Petroleum mining is the leading economic activity in Libya. The country's oil fields are located in the Sahara.

The status of women in Libya has changed dramatically in the late 1900's. Women once received little or no education and were largely confined to the home. Today, they have the legal right to participate fully in Libyan society. However, many traditional attitudes about women remain. Libyan women make up only about 10 per cent of the work force, but this percentage is increasing as more women become educated.

Religion. Islam is Libya's official religion. Almost all Libyans are Muslims and belong to the Sunni branch of Islam. The constitution requires that all legislation must agree with Islamic law.

Land and climate

The huge Sahara, the desert that extends across northern Africa, covers about 95 per cent of Libya. Except for scattered desert oases, only the land near the Mediterranean Sea in northern Libya is habitable and useful for agriculture.

Huge sand dunes make up most of the inland desert region of Libya. A part of the Sahara called the Libyan Desert covers the eastern part of the country's inland area. The desert terrain rises gradually from north to south, forming rugged mountains along the southern border. Libya's highest point, Bette Peak, rises 2,286 metres above sea level in the southeast.

Facts in brief about Libya

Capital: Tripoli.
Official language: Arabic.
Area: 1,759,540 km². *Greatest distances*— north-south, 1,497 km; east-west, 1,690 km. *Coastline*—1,685 km.
Population: *Estimated 1996 population*—5,587,000; density, 3 people per km², distribution, 76 per cent urban, 24 per cent rural. *1984 census*—3,637,488. *Estimated 2001 population*—6,590,000.
Chief products: *Agriculture*—tomatoes, wheat, livestock, olives, potatoes, dates, citrus fruit, barley. *Manufacturing*—petroleum products. *Mining*—petroleum.
National anthem: "Allho Akbar Fawqa Kayd Al-Motadi" ("God Is Greater Than the Aggressor's Malice").
Flag: The flag of Libya is entirely green. Green is the traditional colour of Islam, the religion of most Libyans. Adopted in 1977. See **Flag** (picture: Flags of Africa).
Money: *Currency unit*—Libyan dinar. One dinar=1,000 dirhams.

The desert climate is characterized by extreme high and low temperatures. Daytime temperatures reach an average high of 38 °C. But nights are cool, averaging 10 °C. Rainfall in the desert averages less than 5 centimetres each year.

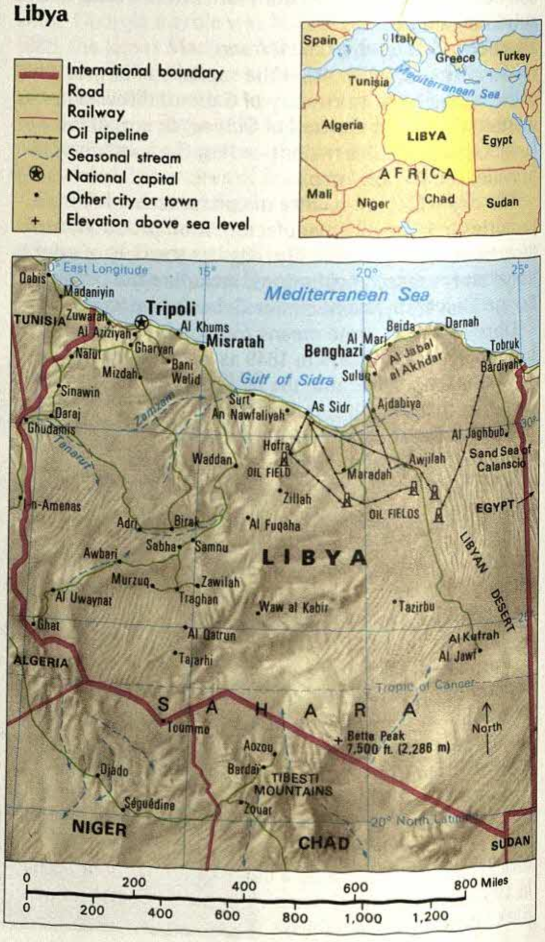
Economy

Libya has a developing economy that depends heavily on petroleum. But the oil industry employs only a small percentage of the country's workers. Most Libyan workers are employed by service industries and agriculture. The government controls most economic activities.

Mining. Petroleum serves as the basis of the economy. It accounts for about 50 per cent of the value of Libya's total economic production, and for almost all the country's export earnings. The national government controls petroleum mining. Libya also has small amounts of gypsum, iron ore, lime, natural gas, and sulphur.

Manufacturing makes up about 4 per cent of the value of Libya's total economic production. The most important manufactured goods are refined petroleum products and petrochemicals. Other products include cement, processed foods, and steel. Libya's northern cities are the chief manufacturing centres.

Libya



Agriculture accounts for only about 2 per cent of the total value of economic production in Libya, but about 18 per cent of Libya's people are farmers. Only about 5 per cent of the land is agriculturally useful, and Libya must import most of the food it needs. The country's chief crops include tomatoes, wheat, olives, potatoes, dates, citrus fruit, and barley. Farmers and herders also rear such livestock as cattle, sheep, and chickens.

Trade. The export of oil and petroleum products accounts for almost the total value of Libyan exports. Food, machinery, textiles, and transportation equipment are major imports. Germany, Italy, and the United Kingdom are Libya's main sources of imports. Chief markets for exports include Germany, Italy, and Spain.

History

Early days. Berbers are believed to be the earliest inhabitants of Libya. In the 600's B.C., Greek colonists settled in the northeastern part of the region. Their province became known as Cyrenaica. In the 400's B.C., the ancient city of Carthage, in what is now Tunisia, established trading centres in the northwestern part of the region. This province became known as Tripolitania.

The Romans destroyed Carthage in 146 B.C., and Tripolitania became part of the Roman province of Africa Nova. A Germanic tribe called the Vandals captured the region in A.D. 431. In the 500's, Byzantine forces conquered the region. Rebellions by Berber tribes created instability that aided Arab entry into the region.

Arab soldiers, spreading their new religion of Islam, entered Cyrenaica in 642 and occupied Tripoli in 643. A succession of Arab and Berber dynasties then controlled what is now Libya. The culture of northwestern Libya developed along with the political units just west of it, while development in the east was strongly influenced by neighbouring Egypt.

In 1551, Ottoman Turks captured Tripoli. They incorporated Tripolitania, Cyrenaica, and the southwestern region known as the Fezzan into their empire, which was centred in Asia Minor (now Turkey). But local rulers had almost complete freedom. From the 1500's to the early 1800's, Barbary pirates preyed on European and U.S. shipping in the Mediterranean. The United States fought a war against the corsairs in the early 1800's.

Italian control. Italy invaded the coastal regions in 1911 and took control of the three provinces in 1912. During the 1920's and 1930's, the Italians sponsored many improvement projects, such as towns, roads, and irrigation systems, luring thousands of European immigrants to the country. But in Cyrenaica, the Sanusi brotherhood, a Muslim religious and social reform group, organized stiff opposition to Italian rule.

During World War II (1939-1945), members of the Sanusi brotherhood cooperated with the United Kingdom (UK) in Egypt against Italy. In 1942, the UK established a military administration in the north. French forces captured and took control of the Fezzan.

Independence. In December 1951, the United Nations called for the independence of all of Libya. A united kingdom came into being, with Muhammad Idris al Mahdi as-Sanusi, leader of the Sanusi resistance, as king. The three provinces—Cyrenaica, Tripolitania, and the Fezzan—had considerable authority to rule themselves. But their separate geographical and cultural development fostered an atmosphere of localism and rivalry that complicated the nation-building process. The provinces were abolished in 1963, and Libya became a monarchy controlled largely by the central government.

The discovery of oil in Libya in 1959 transformed the country from a poverty-stricken nation into one of the wealthiest in the world. But widespread discontent resulted, because the ruling class controlled the wealth.

In September 1969, a group of officers known as the Revolutionary Command Council (RCC) overthrew King Idris and seized power. Colonel Muammar Muhammad al-Qadhafi, who led the revolution, became the head of Libya's government. Under his rule, the government took control of most economic activities. Qadhafi tried to forge unions with a number of Arab states. But none of these efforts succeeded for more than a brief period.

During the 1970's, oil revenues were used to fund ambitious social and economic development projects. Existing political institutions were replaced by popular assemblies. Despite the appearance of democracy, Qadhafi's government tolerated no political opposition.

Libya supported a number of radical movements throughout the world, particularly the Palestine Liberation Organization (PLO). It involved itself in rebellions in Chad and Morocco. Libya also supported Iran's declaration of an Islamic republic in 1979.

Libya today. The leaders of many nations have denounced Qadhafi for interfering in the affairs of other countries. During the 1980's, bitter antagonism surfaced between Libya and the United States. The United States accused Qadhafi of aiding international terrorists. Libya, in turn, charged that the United States was attempting to overthrow its government.

In January 1986, U.S. President Ronald Reagan broke all economic ties with Libya. That March, Libya fired missiles on U.S. military aircraft over the Gulf of Sidra. In April, Reagan ordered U.S. planes to bomb military installations at Tripoli and Benghazi. Reagan acted in response to evidence that linked Libya to the bombing of a West Berlin nightclub, in which an American serviceman was killed and many were injured.

During the 1980's, increased production and decreased consumption of petroleum throughout the world caused Libya's oil revenues to decline. This drop in income slowed Libya's economic development. Facing the prospect of domestic problems, Qadhafi worked to diminish Libya's isolation by improving relations with neighbouring countries.

Libyan agents were suspected of planting a bomb on a U.S. airliner that exploded over Lockerbie, Scotland, in 1988, killing 270 people. The following year, 171 people lost their lives in a similar explosion aboard a French airliner. In April 1992, the United Nations (UN) imposed sanctions on Libya for refusing to hand over two suspected bombers. International air service to Libya was cancelled, military sales were suspended, and Libya's diplomatic corps was reduced in some countries. Sanctions were increased in November 1993 when the UN voted to freeze Libya's overseas assets and impose a ban on sales of oil equipment to Libya.

Related articles in *World Book* include:

Barbary States
Benghazi
Berbers
Qadhafi, Muammar Muhammad al-
Tripoli
World (picture: Making barren land productive)

Libyan Desert. See Egypt (Land).

Licad, Cecile (1961-   ), a Filipino concert pianist, gained international fame in the 1980's. She played her first professional concert in the United States in 1980, with the Boston Symphony Orchestra conducted by the Japanese conductor, Seiji Ozawa. Her performance at the Tanglewood Festival, Massachusetts, won her the Leventritt award. In 1981, Licad began her first full concert season with the New York Philharmonic orchestra under the Indian conductor, Zubin Mehta.

Cecile Buencamino Licad was born in Manila. A descendant of the Filipino composer Francisco Buencamino, she grew up in a musical environment. Her first formal piano lessons took place when she was 5 years old. She played in her first concert at the age of 7. At the age of 11, she was admitted to the Curtis Institute in Philadelphia, U.S.A.

Lice. See **Louse.**

Lichen is an organism that consists of an alga and a fungus living together as a single unit. The alga can make its own food with the help of sunlight. The fungus cannot make its own food, but it absorbs water rapidly.

There are about 20,000 species of lichens. Some grow on soil, but most grow on rocks or tree bark. Lichens live in many regions in which few plants can survive. Some species live in the extreme cold of the Arctic. Others live in deserts or on mountains.

Lichens have no roots. They have an outer layer of fungal cells that are pigmented green, brown, yellow, or grey. This protective layer, called the *upper cortex,* covers a zone of green or blue-green algal cells. Below the algal cells lies a food storage zone called the *medulla* and a further protective layer called the *lower cortex.* Most lichens have *rhizines* (fungal strands) that attach the undersurface of the lichen to the tree or rock.

Botanists recognize three groups of lichens. *Fruticose lichens* are shrublike and are attached only at the base to the *substratum* (surface on which they grow). *Foliose lichens* are leaflike in appearance. *Crustose lichens* are crustlike and are attached to the substratum by the whole undersurface.

How lichens grow. Because lichens have no roots, they grow only when moistened by dew or rain. When a moist lichen absorbs sunlight, the algal part produces sugar by *photosynthesis* (see **Photosynthesis**). Most sugar passes to the fungus, which uses it as a food, thus enabling the entire organism to grow. Dry lichens do not grow, but they can survive extreme temperatures that kill moist lichens. Most lichens add about 3 millimetres a year to their radius, but a few species grow about 10 times as fast. Many crustose lichens grow only 0.3 millimetre yearly. In Arctic regions, these lichens may be as much as 4,000 years old.

Lichens reproduce in three ways. In most lichens, the fungus releases *spores* (microscopic cells) into the air. If a spore lands near a suitable alga, it grows around the alga and a new lichen is formed. Many lichens also reproduce by means of *soredia.* Soredia consist of several algal cells surrounded by a web of fungal strands. They form on the surface of a lichen and are carried away by wind or raindrops. If soredia get trapped in a crack of a tree or rock, they may begin to grow into new lichens. Some lichens produce *isidia* instead of soredia. Isidia are tiny, peg-shaped growths on the lichen's surface. Like soredia, they are distributed by wind and water.

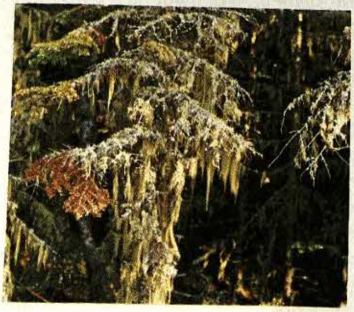
The importance of lichens. Both animals and human beings benefit from lichens. In the Arctic, lichens cover much of the ground, providing winter food for reindeer and caribou. In other regions, many snails, slugs, and insects eat lichens. In the past, people used lichens in many ways. Some species were used as food during famines. Others were used as dyes or as drugs.

Today, manufacturers use vast amounts of a lichen called *oakmoss* each year. Oakmoss is collected in Europe and North Africa for processing into a *fixative* for perfumes, after-shave lotions, and soaps. Another lichen, called *canary weed,* is used to make *litmus,* a substance used to determine if a solution is an acid or a base (see **Litmus**).

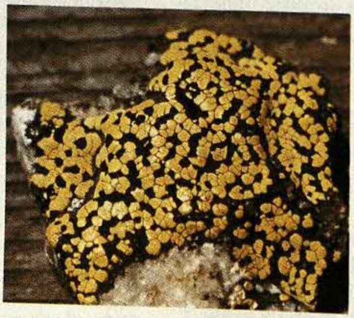
For more than 2,000 years, doctors have used drugs made from lichens to treat certain lung and skin disorders. Until recently, antibiotics were produced from lichens in Scandinavia, Germany, and the Soviet Union. These are now made more economically from fungi.

Scientists use lichens to determine the amounts of certain pollutants in the air. Lichens die when exposed to sulphur dioxide, a poisonous gas that has many harmful effects. Thus, scientists can estimate the amount of sulphur dioxide in the air by observing the number and type of lichens growing at a particular site. Lichens also

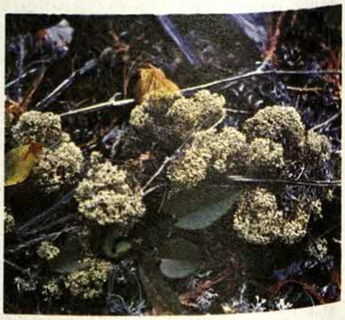
Some kinds of lichens



Old man's beard, one of the most unusual lichens, hangs from tree branches. It grows up to 1.5 metres long.



Yellow map lichens rank among the oldest living things. Scientists believe some of them are thousands of years old.



Arctic lichens cover much of the ground surface in the tundra. They provide food for caribou and reindeer.

absorb metals. By analysing lichens that grow near factories and smelters, scientists can determine the type of metallic pollutants released.

Scientific classification. Scientists traditionally have considered fungi as part of the phylum Eumycophyta in the plant kingdom, Plantae. Today, however, biologists regard fungi as a separate kingdom. Most lichens belong to the class Ascomycotina. A few belong to the class Basidiomycotina.

See also **Symbiosis.**

Lichfield (pop. 90,700) is a local government district in Staffordshire, England, centred on the historic city of Lichfield. The district is mainly agricultural but it has some manufacturing industries. The city of Lichfield has a three-spired cathedral, completed in the 1300's. The city was the birthplace of writer Samuel Johnson.

Lichfield, Patrick, Earl of (1939-), is a British photographer, well known for his portraits of royalty. The son of the fifth Earl of Lichfield, he was named Thomas Patrick John Anson. He was educated at Harrow School and the Royal Military Academy, Sandhurst. He was a regular soldier from 1957 until 1962, becoming a lieutenant in the Grenadier Guards. Lichfield's photographs have appeared in newspapers and magazines around the world. His books include *Royal Album* (1982) and his autobiography *Not the Whole Truth* (1987).

Patrick Lichfield was born in London.

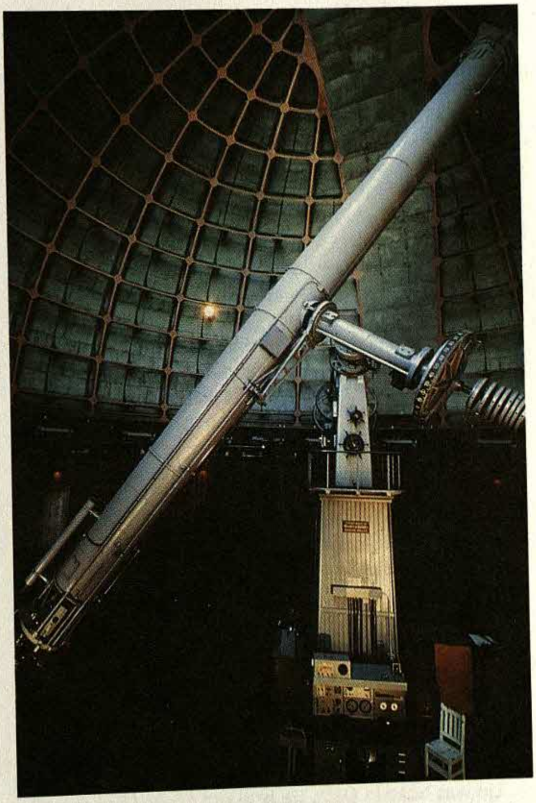
Lichtenstein, Roy (1923-), an American painter, was one of the first artists in the pop art movement. During the early 1950's, Lichtenstein became interested in mass-produced commercial illustrations, especially comic strips and advertisements. He began to isolate single products and single frames of comic strips on a large canvas surface. He thus drew attention to the most common pictorial images in daily life and made them the subjects of art. Many of Lichtenstein's comic strip paintings include nonsense words used to describe sounds or a portion of dialogue. For examples, see **Pop art** and **Painting** (Pop art).

Lichtenstein eliminated visible brushstrokes from his painting surface. He also tried to duplicate the grainy pattern of newsprint. His paintings are composed of regularly spaced dots of mostly primary colours on white backgrounds with black outlines. As his style developed, Lichtenstein adopted subjects such as other artists' paintings, Greek temples, and sunsets. He also began to create sculptures and prints in his painting style. He was born in New York City.

Lick Observatory is an astronomical observatory on top of Mount Hamilton, 80 kilometres southeast of San Francisco in the United States. It is operated by the University of California; and since 1966, its headquarters have been on the Californian campus of Santa Cruz.

The observatory includes buildings for its seven telescopes, and housing for scientists and other personnel is also on the mountain, which rises about 1,280 metres above sea level. The largest telescope is a reflector with a mirror 305 centimetres in diameter. It is equipped with computers and solid-state light detectors.

In 1929, Robert Trumpler of the observatory staff discovered the existence of dust clouds between stars. George Herbig later showed that stars form from the densest of these clouds. In 1969, Joseph Wampler and Joseph Miller used the observatory's 120-inch (305-centimetre) reflector to make the first photograph of the "flashes" of a *radio pulsar.* A radio pulsar is a small, rapidly rotating star that emits radio waves. Today, astronomers use this reflecting telescope to conduct research into such subjects as exploding galaxies, the expansion of the universe, and the origin of the elements.



The 91-centimetre Clark Refractor at the Lick Observatory is the world's second largest refracting telescope.

See also **Cosmology; Telescope.**

Lidgett, John Scott (1854-1953), an English Methodist minister, played a leading part in uniting the factions of the Methodist Church (see **Methodists**). In 1932, he was elected president of the Uniting Conference, the highest position in the Church. He worked toward reunion of the Free Churches and eventual reunion of all Christian Churches. Lidgett was born in London.

Lidice was a village in Czechoslovakia that German military forces destroyed in an act of revenge during World War II. Lidice became a symbol of Nazi cruelty.

German troops occupied Czechoslovakia in 1939. In May 1942, Reinhard Heydrich, a Nazi who controlled much of the country, was fatally wounded. The Nazis claimed that residents of Lidice helped kill Heydrich. But no evidence was found to support this claim. On June 10, 1942, the Germans shot all of Lidice's approximately 180 men. The Nazis sent the rest of the villagers, about 200 women and 100 children, to concentration camps. There, about 50 of the women and nearly all the children were killed. The village was torn down. After the war, some of the survivors built a new village called Lidice near the original site, near Prague, in what is now the Czech Republic. For location, see **Czech Republic** (map). The original site now serves as a memorial to the sufferings of Czechoslovakia under German occupation.

Lido. See Venice.

Lidocaine. See Lignocaine.

Lie, Marius Sophus (1842-1899) was a Norwegian mathematician known for his work in *group theory* and *differential geometry.* After studying at the University of Christiana in Oslo, he went in 1870 to Paris where he worked on *transformation groups* with the German mathematician, Felix Klein.

When the Franco-Prussian War broke out in the same year, Lie travelled to Italy and Switzerland. In 1872 he returned to Oslo and became a professor of mathematics at Christiana University. There he published several important works on *differential equations* and developed the theory of *monotonic transformation groups.* However, he received little recognition in Norway.

In 1886 Lie went to Leipzig, where he took over Felix Klein's chair in mathematics. In Leipzig, he found a following but his health deteriorated quickly. In 1898 he returned to Christiana University, where the Norwegian government had created a chair in the theory of transformation groups.

Lie, Trygve (1896-1968), a Norwegian statesman, served as the first secretary general of the United Nations. He was elected for five years in 1946, and was continued in office for three years in 1950. He announced his resignation in 1952, and left office in April 1953. The Soviet Union opposed Lie because he supported the UN's action in South Korea. Lie resigned hoping to lessen international tensions.

Lie was born in Oslo. He brought experience and talent in handling political problems to his UN position. He had served as legal counsel to the Norwegian Federation of Labour. When the Labour Party came to power in 1935, Lie became minister of justice. From then until 1946, he held posts as minister of justice, of commerce, and of foreign affairs. In World War II (1939-1945), Lie helped manage supplies for the small Norwegian forces that fought Germany. In 1945 he led Norway's delegation to the UN Conference in San Francisco.

A lie detector measures and records a person's physical reactions to questions. Such reactions include changes in various body functions that may occur when an individual lies.

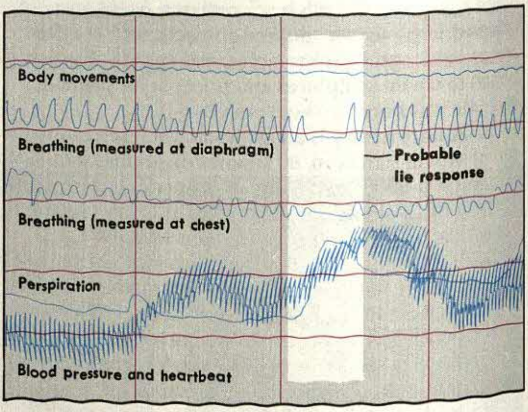
Lie detector is a device that helps determine whether a person is telling the truth. A lie detector, also called a *polygraph,* records physical changes that occur in reaction to questions. Such changes include alterations in the blood pressure, pulse rate, perspiration, and respiration that may occur when an individual lies. In some countries, such as the United States, Israel, and Japan, lie detectors help police and other investigators question suspects about their possible involvement in a crime. In some countries, the devices also help employers screen job applicants and investigate theft by employees.

Polygraph experts and other supporters of lie detector testing believe that such tests are highly accurate. Some American court cases have been decided on the basis of lie detector tests, which can be used as evidence if all people involved agree beforehand to their use. But many legal experts believe that testimony obtained with the aid of lie detectors is not accurate enough to be used in court. In France, the use of lie detectors by the police is illegal. The judges in most criminal cases do not permit testimony obtained with lie detectors to be used as evidence.

A person who agrees to a polygraph test sits in a chair while answering questions. The lie detector records the person's pulse rate, blood pressure, breathing, and perspiration. It makes a continuous record of these body functions by drawing lines on a moving graph.

Some of the questions asked during a lie detector test are related to the matter being investigated. Others are unrelated or only slightly related, but they are included to improve the test's accuracy. Each question must be answered yes or no. If a person lies, the graph normally shows a change in one or more of the body functions being recorded. This change occurs because of the individual's emotional response to telling a lie. A lie detector examiner interprets the test results.

In 1921, John A. Larson, an American psychologist, developed one of the first lie detectors. In 1966, a number of lie detector organizations joined to form an association in America. The association helps supervise the use



A lie detector graph shows how certain body functions change when lying occurs. If the person being tested tells the truth, the graph normally reflects little or no change in the functions being recorded, as shown in the shaded area. If the person lies, the graph normally indicates a change in one or more of these functions, as shown in the unshaded area.

of lie detectors and establishes qualifications for the examiners. In 1972, an American inventor Allen Bell developed a device called a *psychological stress evaluator.* This instrument detects slight tremblings in the voice, which may be interpreted to determine if a person is telling the truth. Most experts agree that the device is not completely accurate, but that it is useful when used together with a polygraph.

Liebig, Baron von (1803-1873), helped found *organic chemistry,* the study of compounds that contain carbon. He made many discoveries in this field and improved the methods of organic analysis. His most important experiments involved the chemistry of the soil. He worked to develop fertilizers, and his book *Chemistry of Food* led to increased knowledge on how to prepare food. Liebig also was one of three discoverers of chloroform. The Liebig condenser, used in distilling liquids, was named after him. Justus Liebig was born in Darmstadt, Germany, and studied in Paris.

Liechtenstein is a tiny country in south-central Europe. It is one of the smallest countries in the world. Liechtenstein covers only 160 square kilometres. For Liechtenstein's total population, see the *Facts in brief* table with this article.

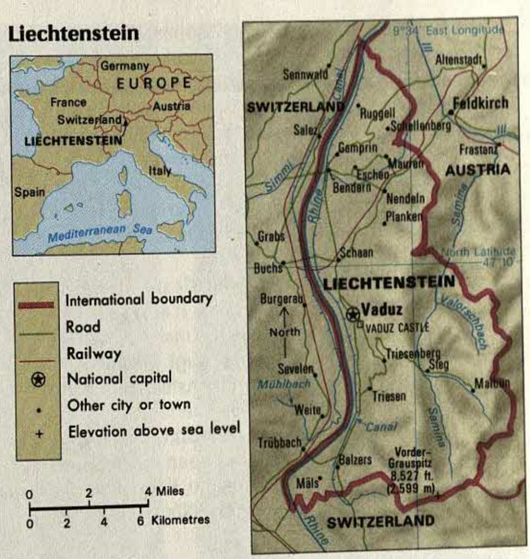
Liechtenstein lies along the Rhine River between Switzerland and Austria, and has many close ties with the Swiss. Most of the people speak Alemannic, a German dialect. Their customs are much like those of the Swiss. Liechtenstein uses Swiss money, and Switzerland operates its postal, telegraph, and telephone systems. Switzerland also represents Liechtenstein in the country's diplomatic and trade relations.

Like Switzerland, Liechtenstein has maintained its neutrality through several wars. Liechtenstein has not fought in a war since 1866. It has been independent since 1806. Its official name in German, the official language, is Fürstentum Liechtenstein (Principality of Liechtenstein). Vaduz, with about 4,900 people, is the capital and largest town.

Government. Liechtenstein is a constitutional monarchy. It is ruled by a prince who is the head of the House of Liechtenstein. The throne usually passes to the prince's eldest son.

The people elect the 25 members of the *Landtag* (parliament) to four-year terms. The Landtag passes laws, prepares the national budget, and sets tax rates. Laws must be approved by the prince. A five-member Collegial Board headed by a prime minister handles government operations. Its members are nominated by the Landtag and approved by the prince. Liechtenstein has two political parties, the Patriotic Union and the Progressive Citizen's Party.

Liechtenstein



Facts in brief about Liechtenstein

Capital: Vaduz.
Official language: German.
Area: 160 km^2. *Greatest length*—28 km. *Greatest width*—11 km.
Elevation: *Highest*—2,599 m. *Lowest*—430 m.
Population: *Estimated 1996 population*—31,000; density, 194 people per km^2; distribution, 80 per cent rural, 20 per cent urban. *1980 census*—25,215. *Estimated 2001 population*—31,000.
Chief products: *Agriculture*—beef and dairy cattle, fruit and vegetables, wheat. *Manufacturing*—ceramics, electronic equipment, fabricated metal products, heating appliances, pharmaceutical products.
Flag: Two horizontal stripes, the upper one blue (for the sky), the lower one red (for the glow of evening fires). A crown representing the prince appears in the upper left. See **Flag** (picture: Flags of Europe).
Money: *Currency unit*—Swiss franc. One franc=100 centimes.

People. The people in Liechtenstein, like the Austrians and Swiss, are descended from a Germanic tribe that settled in the Alps during the A.D. 400's. Until the 1930's, most people farmed for a living. Now, more than half of them make a living as factory workers or craftworkers. Less than 10 per cent of the people still farm for a living. Almost all the people are Roman Catholics. Primary and secondary schooling is free, and children must attend school for eight years. Nearly all adults in Liechtenstein can read and write.

One of the world's finest private art collections is owned by the prince. It is housed in Vaduz, and includes works by Pieter Bruegel the Elder, Sandro Botticelli, Rembrandt, and Peter Paul Rubens.

Land. The Rhine River flows along the western border of Liechtenstein. A narrow strip of flat farmland lies next to the river. Snow-topped mountains cover most of the country's eastern and southern sections. The mountain slopes are covered with pine forests and fine grazing meadows.

Liechtenstein has a mild climate for a country surrounded by high mountains. Warm spring winds provide good weather for growing fruit. The average yearly temperature is 8 °C, and precipitation averages about 90 centimetres a year.

Economy. Since about 1950, Liechtenstein has changed from a farming country to a highly industrialized one. It has one of the world's highest standards of living. In 1991, Liechtenstein joined the European Free Trade Association, which is a trade group that also includes Switzerland and some Scandinavian countries.

Products made in Liechtenstein include ceramics, electronic equipment, fabricated metal products, heating appliances, and pharmaceutical products. Farmers rear beef and dairy cattle in upland meadows, grow grapes and other fruit on upland slopes, or grow wheat or maize, potatoes, and other vegetables in the Rhine Valley. About 5,000 of the 12,000 workers in Liechtenstein's industries come from neighbouring countries.

The government collects money by taxing foreign businesses that set up their headquarters in Liechtenstein. Liechtenstein offers low taxes to such companies, and over 5,000 firms from other countries have established headquarters there. Tourism is also an important source of income for Liechtenstein.

Liechtenstein has two hydroelectric plants that produce electric power for the country. It also sells some power to Switzerland. Trains on the main railway line from Switzerland to Austria go through Liechtenstein. But only a few trains stop in Liechtenstein. Buses link Liechtenstein with Austria and Switzerland.

History. Because of its central location in Europe, the area that is now Liechtenstein has been continuously inhabited since 3000 B.C. Charlemagne, king of the Franks, controlled the area in the late A.D. 700's. After his death in the early 800's, the region was divided into two independent states, Vaduz and Schellenberg. Both states later became part of the Holy Roman Empire. Johann-Adam Liechtenstein, a prince from Vienna, acquired Schellenberg in 1699 and Vaduz in 1712. His descendants still rule Liechtenstein.

Vaduz, Liechtenstein's capital, lies on the west side of the country. The castle on the cliff overlooking Vaduz's main street is the home of the prince of Liechtenstein.

Liechtenstein has been an independent state since 1719, except for a brief period during the early 1800's when Napoleon I of France controlled it. In 1815, Liechtenstein joined the German Confederation, a league of German rulers, but kept its independence. The confederation was dissolved in 1866 at the end of the Seven Weeks' War. This was the last war in which Liechtenstein fought. It has remained neutral since then and has had no army since 1868. In 1924, Liechtenstein agreed on an economic union with Switzerland.

Until 1984, only men were allowed to vote in Liechtenstein's elections. Women were given the right to vote in national elections that year, though they are still not permitted to vote in many local elections. Prince Franz Josef II died in 1989. He was succeeded by his son Prince Hans Adam, who had ruled in his place since 1984.

See also **Vaduz.**

Lieder is the German word for *songs.* The term refers particularly to art songs written by German composers during the romantic era of the late 1700's and the 1800's. Franz Schubert was probably the most important composer of lieder. Other major composers included Robert Schumann, Johannes Brahms, Hugo Wolf, and Gustav Mahler. Most lieder were written for voice and piano accompaniment. Most express a love of nature and were composed to words of great German romantic poets, including Goethe and Heinrich Heine.

Liège (pop. 207,496; met. area pop. 410,160) is a city in eastern Belgium. It lies on both banks of the Meuse River, in the French-speaking part of Belgium (see **Belgium** [political map]). Liège has many iron and steel factories and zinc smelters that work closely with nearby mines. It is famous for the manufacture of guns and glassware. Liège has a university that was founded in 1817. It is a leading cultural centre of Belgium. Opposing armies fought bitterly for control of Liège in World Wars I and II because of its strategic location and its products.

Lien is a legal claim that one person has on the property of another as security for debt. A lien is similar to a mortgage (a loan on property). But, unlike a mortgage, a lien cannot be *assigned* (transferred) to another person (see **Contract; Mortgage**). The main types of liens are *common-law liens* and *statutory liens.* Common-law liens developed from judges' decisions in similar cases. Statutory liens are defined by laws passed by legislatures. A *mechanic's lien* is an example of a statutory lien. This lien gives building contractors assurance that they will be paid for their work and material.

Common-law liens may be either *specific* or *general.* A specific lien gives the holder the right to retain the property that is the basis for the debt that is owed. For example, a storage company owner may obtain a specific lien to hold goods stored by the company until the storage is paid for. A general lien gives the holder the right to property other than that which is the basis of the debt due.

The earth's incredible variety of living things includes tiny one-celled organisms like the amoebas, *upper left,* as well as huge animals like the elephant, *right.* The cactus, *lower left,* and the praying mantis, *centre,* represent the two largest groups of living things—plants and insects.

Life

Life. Most people have little difficulty distinguishing living things from nonliving things. For example, they easily recognize that a butterfly, a horse, and a tree are alive but a bicycle, a house, and a stone are not. People call a thing living if it is capable of certain activities, such as growth and reproduction.

Biologists, however, find it hard to define life, though they have vast knowledge of living things. They have difficulty locating the dividing line between living and nonliving things. For example, a virus is a lifeless particle by itself, but it becomes active and multiplies rapidly when inside a living cell. Rather than trying to define life precisely, biologists concentrate on deepening their understanding of life by studying living things. The science dealing with the study of life, known as biology, is subdivided into many specialist fields. For example, biochemistry investigates the chemical processes of life; genetics studies the way characteristics are passed from an organism to its offspring.

The earth has an enormous variety of living things—more than 2 million species. They range in size from microscopic bacteria to gigantic blue whales. Living things can be found in all kinds of environments. Some organisms live in sun-scorched deserts. Others flourish in icy polar waters. Still others thrive in steamy jungles. Living things also vary widely in their behaviour and food requirements. In spite of their differences, however, all living things consist of the same kinds of chemicals and carry out the same kinds of chemical reactions.

Scientists have long sought definite answers to two major questions about life: "How did life begin on the earth?" and "Does life exist elsewhere in the universe?" Research into these matters is underway both on the earth and in space. This research should help experts begin to formulate scientific theories that can be tested through experiments.

The characteristics of living things

Nearly all living things share certain basic characteristics. These characteristics include (1) reproduction; (2) growth; (3) metabolism; (4) movement; (5) responsiveness; and (6) adaptation. Not every organism exhibits all these features, and even nonliving things may show some of them. However, these characteristics as a group outline the basic nature of living things.

Reproduction is the process by which living things create more of their own kind. There are two major types of reproduction—*asexual* and *sexual.* In asexual reproduction, a new organism develops from one existing organism. Some lower forms of animals and plants reproduce asexually. In sexual reproduction, a new organism develops from the union of two sex cells. In most cases, these cells come from two parents—one male and one female. Human beings and most higher animals and plants reproduce sexually. See **Reproduction.**

Growth is the orderly increase in size that organisms undergo as they mature. Plants grow by taking in simple molecules, such as carbon dioxide and water, and chemically converting them into complex plant materials. Animals grow by eating food and converting it into animal tissue. Biological growth differs from *accretion.* In this process, some nonliving things increase in size through the addition of new layers to their surfaces. For example, a salt crystal becomes larger through the accumulation of new layers of salt. See **Growth.**

Metabolism involves all the chemical processes by which an organism converts molecules and energy into forms that it can use. Metabolism supplies the molecular building blocks an organism needs for the growth of new tissues and the replacement of worn-out parts. These building blocks must either come from the breakdown of food material or be built up from simpler molecules within the organism.

Biological energy comes chiefly from sunlight. The energy is trapped by plants during the process of *photosynthesis* and stored in chemical compounds. All other biological activities in animals and plants depend on conversions of this energy into useful forms. Most such conversions occur in an organism through the combination of food with oxygen. This process, called *oxidation,* produces water, carbon dioxide, and many molecules of a high-energy compound called *adenosine triphosphate (ATP).* ATP molecules hold energy in its most biologically useful form and release the energy as it is needed. See **Metabolism.**

Movement. Most living things move in some way. Plants have internal motions, such as the flow of sap. A plant may also bend toward the light, and its flowers may close at night. Movement is more obvious in most animals, which, unlike plants, must search about for food. Some animals, however, move only internally. For example, a sponge circulates water laden with food particles through its otherwise stationary body.

Responsiveness. Living things can sense and respond to changes in their surroundings. Changes that produce responses in organisms are called *stimuli.* Such factors as light and temperature can serve as stimuli. The responses of organisms take various forms, most of which involve some type of movement. For example, a turtle can contract into its shell, a plant can grow toward the sunlight, and a bacterium can swim away from concentrations of harmful substances.

Adaptation is a characteristic of an organism that makes it better able to survive and reproduce in its environment. An adaptation may involve changes in the organism's *genes* (units of heredity), which are passed on from generation to generation. To survive, living things must adapt to long-term changes in the environment. For instance, adaptations have made some species of insects resistant to certain kinds of insecticides (see **Natural selection**). Living things also must adapt to varying short-term conditions in the environment. For example, when a person travels to a foreign country, the body may have to adjust to a different altitude, climate, or diet. See **Adaptation.**

Living things and their environment

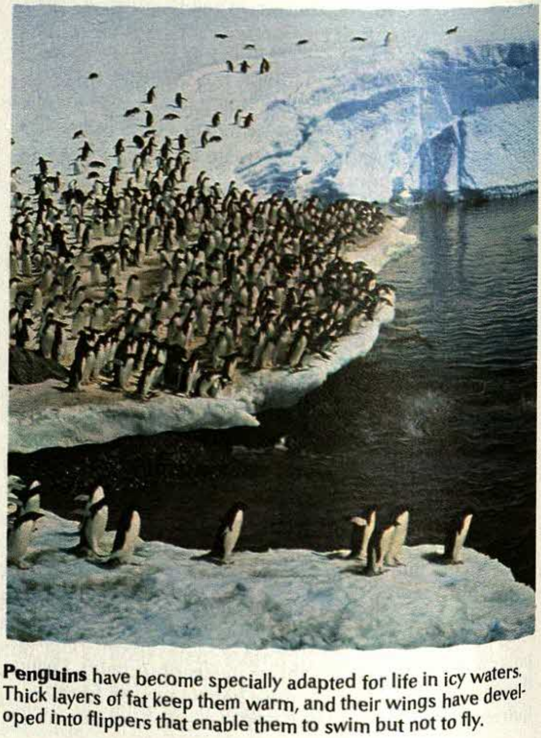
All animals and plants depend greatly on their physical surroundings and on other living things. An organism's environment must provide certain conditions for it to survive. For example, all living things require water and many other chemical substances. In addition, life as we know it can exist only within a limited range of temperatures. Conditions capable of supporting life occur on and near the surface of the earth in a thin region called the *biosphere.*

The study of the relationships between living things and their environment forms the science of *ecology.* Such features as geological formations, climate, and soil make up an organism's *physical environment.* The other living things in the same area form the organism's *biological environment.* See **Ecology.**

The physical environment determines which kinds of plants and animals can live in a given place. In general, areas with a warm climate and plenty of water have a great variety of living things. However, only specially adapted species can live in extreme environments. For example, the penguins of Antarctica have few neighbours in their bitter cold climate. Only a few kinds of algae and bacteria can live in hot springs, where temperatures may reach 85° C.

The biological environment. All members of a given species living in a particular area form a *population.* All animal and plant populations that inhabit the area make up a *community.* The populations in a community relate to one another in many ways. In the most basic relationship, organisms obtain nutrients and energy by eating other organisms. Some kinds of animals eat plants, and others feed on animals. In addition, some types of bacteria and fungi get nutrients and energy from the decaying remains and waste matter of other organisms. Other relationships in a community include (1) competition; (2) parasitism; and (3) mutualism.

Competition occurs when two or more organisms require the same resource, such as food or nesting space.



Penguins have become specially adapted for life in icy waters. Thick layers of fat keep them warm, and their wings have developed into flippers that enable them to swim but not to fly.

The competition may take place between individuals from different populations or between organisms of the same population.

Parasitism occurs when one organism lives in or on another organism, called a *host.* The parasite takes its food from the tissues or digestive system of the host. For example, a tapeworm absorbs digested food from the intestines of its host.

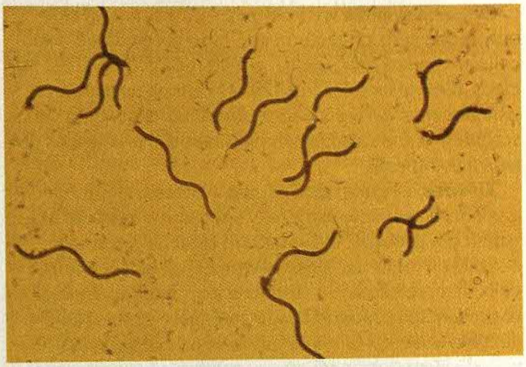
Mutualism is an association between two organisms of different populations that benefits both organisms. For example, two organisms—an alga and a fungus—may live together as a unit called a *lichen.* The alga can make its own food, but it must have water to grow. The fungus absorbs water well, but it cannot produce its own food.

The structure of living things

All living things are made up of cells. The simplest organisms consist of only one cell, but such complex living things as dogs and human beings have many billions of cells.

The simplest organisms, including bacteria and many kinds of algae and protozoans, live their entire lives as individual cells. Some other types of algae and protozoans are *colonial* organisms. Such an organism consists of a loosely organized group of similar cells. Most species of animals and plants are *multicellular* organisms. They are made up of many kinds of cells, each having its own special functions.

The simplest multicellular animals include sponges and jellyfish. Sponges have some specialized cells but resemble colonial organisms. If the cells of a sponge are separated, they can readily rejoin and form a new individual. Jellyfish are somewhat more highly organized and have well-defined tissues. Higher animals have organs and organ systems.

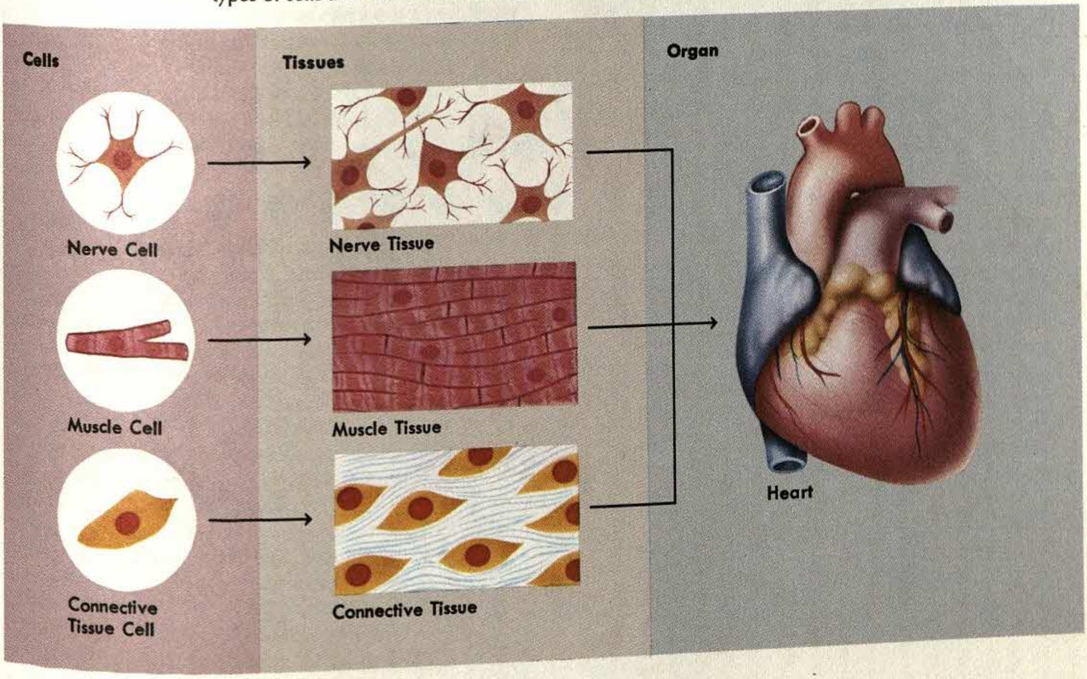


The simplest living things, such as the bacteria shown above, consist of a single cell that lacks a distinct nucleus.

Cells. A thin covering called the *plasma membrane* or *cell membrane* encloses every cell and separates it from its surroundings. All cells except those of bacteria have two main parts—the *nucleus* and the *cytoplasm.* A *nuclear membrane* surrounds the nucleus and separates it from the cytoplasm. The nucleus contains the *chromosomes,* the hereditary material that carries the instructions for nearly all cellular activities. The cytoplasm contains many kinds of specialized structures called *organelles.* Each type of organelle has a specific task, such as manufacturing proteins or converting the energy of food molecules into usable forms.

Structural units of higher organisms

Higher organisms have many specialized kinds of cells. Cells that are similar in structure and function make up a tissue. Tissues, in turn, are grouped together and form organs, which are the basic structural and functional units of higher plants and animals. The illustration below shows the main types of cells and tissues that make up the human heart.



Organelles and a well-defined nucleus are lacking only in the cells of bacteria and blue-green algae. Such cells are called *procaryotic,* which means *before the nucleus.* Biologists refer to all other cells as *eucaryotic,* which means *having a true nucleus.* For a detailed description of the structure of cells, see the article **Cell** (Inside a living cell).

Tissues, organs, and organ systems. Higher organisms have many extremely specialized kinds of cells, which are grouped together and form larger, more complex structures. A *tissue* consists of a collection of cells that are similar in structure and function. Animal tissues include muscle tissue and nerve tissue. Plants also have several kinds of tissues. For example, tissue called *xylem* carries water and minerals from the roots to the rest of the plant.

The basic structural and functional units of higher organisms are *organs.* An organ consists of several types of tissues. The human heart, for example, consists of muscle tissue, nerve tissue, and connective tissue. Other animal organs include the brain, liver, and kidneys. The principal organs of flowering plants are roots, stems, leaves, and flowers.

In higher animals, each important life function is carried out by a group of organs working together. Such a group is called an *organ system.* Major organ systems include the circulatory system, digestive system, and reproductive system.

The chemical basis of life

All the chemical elements that make up living things are also present in nonliving matter. The most common elements in living things are carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulphur. Living things also contain smaller amounts of other elements, including calcium, iron, magnesium, potassium, and sodium.

Water is the simplest chemical compound of importance to living things. Most organisms consist of 50 to 95 per cent water. Many properties of water make it essential to life processes. Its ability to dissolve a great variety of substances is vital because most chemical reactions within organisms can occur only in a water solution. Water itself enters into many chemical reactions in living cells. It also transports nutrients within organisms.

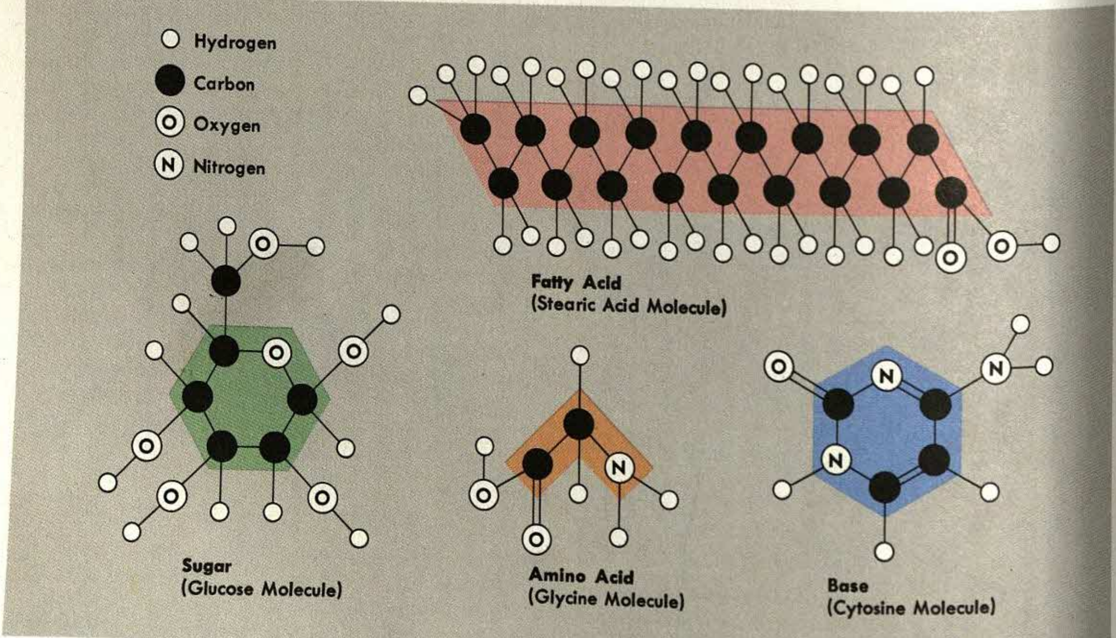
Except for water, all the principal compounds in living things contain carbon. Each carbon atom can form four chemical bonds of great stability with other atoms. Carbon atoms can also bond with one another and form chains of various lengths and shapes. These properties appear to be unique to carbon, and so it is hard to imagine life as we know it based on anything except carbon chemistry.

Carbon can form thousands of kinds of small molecules. However, almost all living material consists of about 50 kinds of carbon molecules and of the *macromolecules* (large, complex molecules) formed from them. There are four main types of these macromolecules. They are (1) carbohydrates; (2) lipids; (3) proteins; and (4) nucleic acids.

Carbohydrates consist of carbon, hydrogen, and oxygen. Carbohydrates contain these elements in the proportion of roughly 1 atom each of carbon and oxygen to every 2 atoms of hydrogen. The basic carbohydrate molecules are simple sugars called *monosaccharides.* Sugars provide energy to power all cellular processes.

The importance of carbon in life

The ability of carbon atoms to form chains of various lengths and shapes is fundamental to the chemistry of life. The four main types of biological molecules—carbohydrates, lipids, proteins, and nucleic acids—consist of smaller carbon-containing molecules like those below. Sugars are found in carbohydrates, fatty acids in lipids, amino acids in proteins, and bases in nucleic acids.



Living things combine simple sugars into long chains called *polysaccharides.* Some polysaccharides serve as a means of food storage. Starches are the main carbohydrate storage material in plants, and *glycogen* serves the same function in animals. Other polysaccharides provide structural support. The polysaccharide *cellulose* is the chief supporting material in green plants. Wood, for example, consists almost entirely of cellulose. See **Carbohydrate.**

Lipids consist primarily of carbon and hydrogen, but they also contain a small proportion of oxygen. Some lipids contain nitrogen and phosphorus as well. The best-known lipids are animal fats and vegetable oils, which are rich sources of energy. Many kinds of organisms store food in the form of lipids.

Other important lipids, such as *phospholipids* and *steroids,* have more complicated structures than do fats and oils. Phospholipids contain phosphorus, and some also contain nitrogen. Layers of phospholipids form the basic structure of cell membranes. Steroids consist of four connected rings of carbon atoms with other atoms and molecules attached. Steroids include such substances as sex hormones, adrenal hormones, and cholesterol. See **Lipid.**

Proteins are far more complex molecules than carbohydrates or lipids. A protein is made up of one or more long chains called *polypeptides.* Polypeptides, in turn, consist of many small molecules called *amino acids.* All amino acids contain carbon, hydrogen, nitrogen, and oxygen. Some also contain sulphur. There are 20 kinds of amino acids in proteins, and each protein molecule may have from about 50 to more than 1,000 amino acid molecules.

Proteins are the most abundant macromolecules in living cells. The many kinds of amino acids and the large number of them in each protein molecule make possible an enormous variety of proteins. Each arrangement of amino acids has different chemical properties and different functions. Proteins can thus carry out a vast range of tasks. Some proteins, such as *keratin* in hair and *myosin* in muscle, form the major structural material in living things. Other proteins have chemical functions. Most such proteins are enzymes, which speed up chemical reactions within cells. Enzymes control cellular activity by determining which chemical reactions will take place in a cell. See **Protein; Cell** (Producing proteins); **Enzyme.**

Nucleic acids store and transmit the information necessary for producing proteins. Nucleic acids consist of long chains of smaller molecules called *nucleotides.* The nucleotides are made of carbon, hydrogen, nitrogen, oxygen, and phosphorus. There are various types of nucleotides, which together compose a sort of code for expressing genetic messages. These messages completely control a cell's structure and activities by determining which proteins will be produced.

There are two main types of nucleic acids, *DNA* (deoxyribonucleic acid) and *RNA* (ribonucleic acid). DNA is the genetic substance in the chromosomes. DNA carries the hereditary information that an organism passes on to its offspring. DNA also determines the kinds of proteins a cell produces. RNA transmits DNA's instructions to the cytoplasm, where it serves as a pattern for building proteins. For a fuller discussion of nucleic acids, see **Nucleic acid; Cell** (The code of life); **Heredity** (The structure of nucleic acids).

The origin of life

Religious explanations. Nearly all religions have had *creation stories* to explain the origin of life. These stories tell how the world and living things were created. For example, the Maoris of New Zealand had a story that life in the world only began after Rangi, the sky, and Papa, the earth, were pulled from each other's embrace. In the Western world, the best-known creation story comes from the Book of Genesis in the Bible. It tells how God created the earth and all living things.

Modern religious thinkers interpret the Biblical story of creation in various ways. Some believe that the creation occurred exactly as Genesis says it did. Others think that the story is a symbolic account of a divine mystery that will never be fully understood.

The theory of spontaneous generation originated in ancient times and remained a common belief for thousands of years. The theory claimed that lower forms of life could arise from nonliving matter. For example, people believed that flies developed from decaying meat and that mice formed from piles of old rags.

During the mid-1600's, an Italian scientist named Francesco Redi conducted experiments which showed that meat protected from flies would not produce maggots. However, Redi's experiments did not end the dispute over spontaneous generation. A belief persisted that microscopic forms of life could arise spontaneously, and the argument raged for about 200 years.

The French chemist Louis Pasteur finally settled the controversy during the mid-1800's. He demonstrated that even the minutest bacteria do not arise spontaneously but always grow from other bacteria. After Pasteur's experiments, most biologists accepted the idea that all life comes from existing life. See **Spontaneous generation.**

Modern theories. During the 1900's, biologists have developed scientific theories of the origin of life. Scientists think that life probably arose on the earth more than 3½ billion years ago, and so they cannot base their understanding of that event on direct observation. As a result, their understanding of how life began is far less certain than their knowledge of such subjects as cell structure and biochemistry. Scientists construct explanations of the origin of life. They base their explanations on their knowledge of living things and on their understanding of the early physical conditions on the earth.

Scientists have proposed two major theories of the origin of life. They are (1) the theory of panspermia and (2) the theory of chemical evolution.

The theory of panspermia states that spores from some other part of the universe landed on the earth and began to develop. However, some scientists doubt that spores could survive a journey through the harsh conditions of outer space. Even if the theory is true, it explains only the origin of life on the earth and not how life arose in the universe.

The theory of chemical evolution was developed independently during the 1920's by a Russian biochemist named Alexander I. Oparin and by J. B. S. Haldane, a British biologist. Most modern biologists now accept this theory. It claims that life developed through a series

Lightning and volcanoes may have played a role in the origin of life on the earth. According to one theory, energy from such sources as lightning, volcanoes, and sunlight powered reactions among the gases in the atmosphere of the early earth. The theory proposes that such reactions produced the first biological molecules in the form of sugars and amino acids.

of spontaneous chemical reactions in the atmosphere and oceans early in the earth's history. Pasteur showed that life cannot arise spontaneously under the chemical and physical conditions present on the earth today. Billions of years ago, however, the chemical and physical conditions on the earth were far different.

Scientific studies indicate that the atmosphere of the early earth contained little or no *free* (uncombined) oxygen. Because hydrogen is the most abundant element in the universe, many scientists have theorized that the earth's early atmosphere had large quantities of hydrogen. Under such conditions, the hydrogen-containing compounds ammonia, methane, and water would also have been abundant. The theory of chemical evolution proposes that energy from such sources as sunlight, lightning, and volcanoes powered reactions among these compounds that produced simple biological molecules. These molecules, such as sugars and amino acids, then combined and formed more complex molecules. Finally, the theory claims that these complex molecules became organized into the first organisms.

Two American chemists, Stanley L. Miller and Harold C. Urey, provided the first experimental evidence in support of the theory of chemical evolution in 1953. They subjected a mixture of ammonia, hydrogen, methane, and water to the energy of high-voltage sparks for one week. After that time, amino acids and other simple biochemical compounds had formed. Scientists have repeated this experiment under various conditions.

Some researchers have assumed that the early atmosphere contained little hydrogen but large quantities of carbon dioxide. They have substituted various hydrogen-poor "atmospheres" for the hydrogen-rich mixture of the Miller-Urey experiment. The hydrogen-poor mixtures also yielded biochemical compounds when exposed to high-voltage sparks. Such experiments have proved that a random process can produce most of the basic molecules of biochemistry. Many other experiments have combined simple biological molecules to form more complex ones.

Other scientific research also suggests that life arose through chemical evolution. The surface of the earth experiences a continuous flow of energy as it receives light from the sun and radiates heat into outer space. Physics research has demonstrated that such an energy flow increases molecular organization. Thus, the evolution of complex biochemical molecules may be viewed as part of this natural process. Other studies have shown that the basic structure of biological membranes will form spontaneously in a mixture of lipids and water. The mere presence of the right type of molecules seems to guarantee the formation of biological membranes.

Although scientists have experimental evidence to support parts of the theory of chemical evolution, many questions remain. For example, biologists are still searching for an explanation of how biological molecules could have first become organized into cell-like organisms. They are also trying to discover how nucleic acids and proteins became related in such a way that nucleic acids determine the kinds of proteins a cell produces. A complete theory of the origin of life will have to explain this relationship, which is a basic characteristic of life as we know it.

The search for life on other planets

The theory of chemical evolution suggests that life arises naturally under certain physical and chemical conditions. Astronomers believe that these conditions have probably existed in many places throughout the universe. Thus, many scientists conclude that life may have arisen on numerous other planets. The search for and study of life elsewhere in the universe make up the science of *exobiology*. See **Exobiology**.

Exobiologists think that the chemistry of life anywhere in the universe would basically resemble that of life on the earth. However, the living things on another planet would have developed in response to the specific environmental conditions there. As a result, the life forms would almost certainly differ greatly in structure and appearance from those on the earth.

The development of space travel during the 1960's provided the opportunity to search for life on neighbouring planets in our solar system. At that time, scientists thought that life might exist on two of those planets—Venus and Mars. The harsh environments on the other planets in our solar system make it highly unlikely that life could exist on any of them.

During the 1960's, the United States and the Soviet Union sent missions to Venus. These missions revealed that environmental conditions on the surface of Venus could not support life as we know it. However, some scientists believe that organisms could exist in the clouds that surround Venus.

In 1976, two United States space probes, *Viking I* and *Viking II,* landed on Mars and performed several experiments to test for life. These experiments indicated chemical activity in Martian soil, but a highly sensitive chemical detector failed to detect any organic compounds. Scientists thus concluded that the results of the experiments probably were due to high-energy chemicals in the soil. Some researchers, however, still believe that organisms may be present, and other missions have been recommended.

Exobiologists think that many stars beyond our solar system may have planets on which life could exist. However, enormous distances separate the earth from the stars. With our present technology, it is difficult even to detect the presence of other planets, much less to search for life on them. We can therefore learn of life on distant planets only if they are inhabited by intelligent beings capable of communicating across the vast reaches of space. Some scientists have begun using radio telescopes to listen for communication signals from distant civilizations.

Related articles in ***World Book*** include:

Adaptation
Biogenesis
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Growth
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Metabolism
Oparin, Alexander I.
Pasteur, Louis
Protoplasm
Reproduction
Spontaneous generation
Zoology

Outline

I. The characteristics of living things
- A. Reproduction
- B. Growth
- C. Metabolism
- D. Movement
- E. Responsiveness
- F. Adaptation

II. Living things and their environment
- A. The physical environment
- B. The biological environment

III. The structure of living things
- A. Cells
- B. Tissues, organs, and organ systems

IV. The chemical basis of life
- A. Carbohydrates
- B. Lipids
- C. Proteins
- D. Nucleic acids

V. The origin of life
- A. Religious explanations
- B. The theory of spontaneous generation
- C. Modern theories

VI. The search for life on other planets

Questions

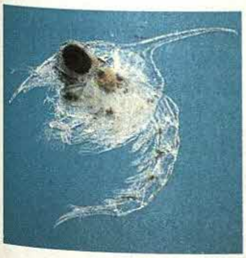
What are some basic characteristics of living things?
What features make up an organism's physical environment?
How do cells of bacteria and blue-green algae differ from all other cells?
What is the chief source of biological energy?
What experimental evidence do scientists have to support the theory of chemical evolution?
How many species of living things exist on the earth?
What are the two main ways in which living things adapt to changes in the environment?
Why is water essential to life processes?
What is *exobiology*?
In what ways do organisms use carbohydrates?

Life cycle is the sequence of changes that a living thing passes through from a particular form in one generation to the development of the same form in another generation. Growth and reproduction always take place in every generation.

The life cycle of mammals is relatively simple. They develop from a fertilized egg to an adult by growth. The adults produce *gametes* (sex cells). Fertilization of the egg begins development of a new individual. Many lower organisms have even simpler life cycles. But most plants and some animals go through complex life cycles, involving more than one kind of individual. In many, a generation of sexual reproduction follows one of asexual reproduction. The sequence of changes through which an organism passes during its lifetime is called its *life history.*

Related articles in ***World Book*** include:

Alternation of generations
Generation
Life
Metamorphosis
Reproduction



The life cycle of a crab begins when the eggs hatch out into swimming larvae, which pass through four stages. The third stage is the zoea *(above).* It has all the legs and mouthparts of the adult crab *(right).*

Life expectancy at birth for selected countries

Country	Males	Females
Africa		
Algeria	65.0	67.3
Angola	44.9	48.1
Benin	46.4	49.7
Burkina Faso	47.6	50.9
Burundi	47.8	51.2
Cameroon	53.5	56.5
Central African Republic	48.0	53.0
Chad	45.9	49.1
Congo	52.1	57.3
Egypt	60.4	62.8
Ethiopia	45.4	48.7
Ghana	54.2	57.8
Guinea	44.0	45.0
Ivory Coast	52.8	56.2
Kenya	59.0	63.0
Lesotho	54.0	63.0
Liberia	54.0	57.0
Libya	61.6	65.0
Madagascar	54.0	57.0
Malawi	48.4	49.7
Mali	44.4	47.6
Mauritania	46.4	49.7
Mauritius	67.9	72.6
Morocco	61.6	65.0
Mozambique	46.9	50.2
Niger	44.9	48.1
Nigeria	50.8	54.3
Rwanda	48.8	52.2
Senegal	48.3	50.3
Sierra Leone	41.4	44.6
Somalia	45.4	48.6
South Africa	60.0	65.9
Sudan	50.6	53.0
Tanzania	53.3	56.7
Togo	53.2	56.8
Tunisia	66.9	68.7
Uganda	51.4	54.7
Zaire	52.3	55.7
Zambia	54.4	56.5
Zimbabwe	59.0	62.6
Asia		
Afghanistan	43.0	44.0
Armenia	68.0	74.0
Azerbaijan	65.0	73.0
Bangladesh	53.1	52.6
Burma	60.8	64.3
Cambodia	49.5	52.4
China	69.2	72.6
Georgia	67.0	75.0
India	60.1	60.7
Indonesia	60.9	64.5
Iran	66.6	67.8
Iraq	65.0	67.4
Israel	74.4	78.2
Japan	75.9	81.7
Jordan	66.2	69.8
Kazakhstan	63.0	72.0
Kyrgyzstan	62.0	71.0
Korea, North	67.7	73.9
Korea, South	67.7	73.7
Kuwait	72.2	76.5
Laos	49.5	52.5
Mongolia	62.3	65.0
Nepal	54.0	53.0
Pakistan	59.0	59.0
Philippines	63.1	67.0
Saudi Arabia	64.2	67.7
Singapore	71.8	77.4
Sri Lanka	69.5	73.8
Syria	65.2	69.2
Tajikistan	64.0	70.0
Thailand	65.1	69.2
Turkey	64.5	68.1
Turkmenistan	59.0	66.0
Uzbekistan	64.0	70.0
Vietnam	61.6	66.0
Yemen	52.3	53.0
Australia and Pacific Islands		
Australia	73.7	80.2
New Zealand	72.7	78.6
Papua New Guinea	55.2	56.7
Europe		
Albania	70.3	75.4
Austria	71.6	78.6
Belarus	66.0	76.0
Belgium	72.4	78.9
Bosnia-Herzegovina	68.0	73.0
Bulgaria	70.4	76.1
Croatia	67.0	74.0
Czechoslovakia	68.8	76.0
Denmark	73.3	79.1
Estonia	65.0	74.0
Finland	72.1	79.6
France	72.9	80.8
Germany	72.4	78.5
Greece	74.3	78.7
Hungary	67.9	75.2
Iceland	75.3	81.0
Ireland	72.5	77.9
Italy	73.2	79.6
Latvia	65.0	75.0
Lithuania	66.0	76.0
Macedonia	71.0	75.0
Moldova	64.0	71.0
Netherlands	74.3	80.8
Norway	74.3	80.7
Poland	68.0	76.0
Portugal	71.1	77.7
Romania	68.8	74.2
Russia	63.0	74.0
Slovenia	70.0	78.0
Spain	74.4	80.3
Sweden	75.0	80.7
Switzerland	74.6	80.9
Ukraine	65.0	75.0
United Kingdom	73.3	78.9
Yugoslavia	70.3	75.6
North America		
Canada	74.0	80.7
Costa Rica	72.9	77.6
Cuba	73.9	77.6
Dominican Republic	65.4	69.8
El Salvador	64.0	68.9
Guatemala	62.4	67.3
Haiti	54.9	58.3
Honduras	63.7	68.0
Jamaica	71.4	75.8
Mexico	67.1	73.8
Nicaragua	64.8	67.7
Panama	70.7	74.9
Trinidad and Tobago	69.7	74.7
United States	71.5	78.3
South America		
Argentina	68.1	74.8
Bolivia	53.6	58.3
Brazil	63.5	69.1
Chile	68.5	75.6
Colombia	66.4	72.3
Ecuador	64.5	68.8
Guyana	62.4	68.0
Paraguay	65.1	69.5
Peru	62.7	66.5
Uruguay	69.3	75.7
Venezuela	67.3	73.5

Figures are for the period prior to the independence of Eritrea from Ethiopia and the breakup of Czechoslovakia.
Sources: *World Population Prospects, 1990* UN; U.S. National Center for Health Statistics, Central Intelligence Agency.

Life expectancy is a statistical measure of the average number of years that a group of people of a certain age may expect to live. This measure is based on the death rates by age for a specific population at a specific time. If death rates decline, as has normally happened, life expectancy increases.

The table above compares the life expectancies at birth for the male and female populations of various countries. Life expectancy varies from country to country because of differences in public health and standards of living. In general, the industrial nations have the highest life expectancy. Most females have a higher life expectancy than males.

Life insurance. See **Insurance** (Life insurance).

Life jacket is a device that is worn to keep afloat in water. Most life jackets are filled with light material, such as kapok, plastic foam, fibreglass, cork, or balsa wood. They are often brightly coloured to make them easily visible. Most have no sleeves, so the wearer's arms can move freely.

Life jackets belong to a group of water-safety devices called *personal flotation devices* (PFD's). Other PFD's include *buoyant cushions* (floating pillows) and doughnut-shaped *ring buoys.* These devices can be thrown to a person in the water from a boat or from land.

Lifeboat. Ships carry lifeboats on board to accommodate passengers and crew in the event of a disaster. In Britain and Ireland the term "lifeboat" has a special meaning. About 250 lifeboats are stationed at selected

A life jacket keeps a person afloat in water. Everyone riding in an open boat should wear one at all times.

Lifeboats of the Royal National Lifeboat Institution, like this one from Newcastle, Northern Ireland, are always ready to put to sea to help boats in distress around the coasts of Ireland and Britain.

places round the coasts of Britain and Ireland. The boats are ready to go to sea as soon as any boat is reported to be in danger. The Royal National Lifeboat Institution (RNLI) maintains the lifeboat service in both Britain and the Republic of Ireland. The Institution also operates a relief fleet of about 90 lifeboats. The RNLI encourages people who own boats to help in sea rescues, and rewards those who aid boats in distress.

The types of lifeboats that the RNLI uses include the 14.3-metre Tyne and the 15.86-metre Arun, both capable of 18 knots; the 10.07-metre Brede; the 14.8-metre and 11.3-metre Oakley; the 14.26-metre and 14.34-metre Watson; and the 13.42-metre Waveney. There are also inflatable boats such as the 6.41-metre Atlantic rigid inflatables, which are capable of 30 knots.

The Arun and Brede classes are afloat permanently. Others, like the Tyne, launch down slipways. Some, like the Oakley, launch from a carriage pulled to the sea by a tractor.

Crews of most lifeboats are volunteers who earn their living in other ways. Every lifeboat station has one full-time crew member, usually the motor mechanic. Some stations have more full-time crew members. The usual lifeboat crew consists of from five to seven men. Inflatable lifeboats have a crew of two or three.

Royal National Lifeboat Institution. The National Institution for the Preservation of Life from Shipwreck was founded in England by royal charter in 1824 as a voluntary institution. It later became the Royal National Lifeboat Institution (RNLI). The institution is financed entirely by voluntary contributions. Between 1854 and 1869, the RNLI received a government grant. But, in 1869, it chose to become voluntary again, because of the conditions that the government made in return for its grant. In 1897, a committee of the House of Commons concluded that the government was not justified in taking over the lifeboat service while the RNLI continued to run it efficiently. Governments in World Wars I and II agreed that the service should remain voluntary, even in wartime.

The RNLI cooperates with government agencies that are also responsible for rescuè at sea. These agencies include HM Coastguard and the helicopter rescue services of the Royal Navy and the Royal Air Force. About 115,000 people have been rescued by lifeboat crews since the RNLI was founded.

History. The lifeboat was a British invention. In 1786, Lionel Lukin, a London coachbuilder, converted a fishing *coble* (a small flat-bottomed boat) into a life-saving boat. John Sharp, chief administrator of the Crewe Trust, asked Lukin to send his boat to Bamburgh, Northumberland. The first boat designed as a lifeboat was built by Henry Greathead, a Tyneside boat-builder, and named the *Original*. It was launched in 1790 and served near the mouth of the Tyne for 40 years. Between 1790 and 1824, a number of lifeboats were built and operated locally. Most of them were paid for by Lloyd's (see Lloyd's).

Lifesaving. See **Swimming** (Water safety); **Drowning; First aid.**

Liffey is the chief river in the east of the Republic of Ireland. The Liffey rises in the Wicklow mountains and flows about 80 kilometres through the counties of Wicklow, Kildare, and Dublin before entering the sea at Dublin Bay. The city of Dublin lies at the river mouth. The Liffey is one of the best-known salmon rivers in the British Isles. The Republic of Ireland's electricity authority has three hydroelectric power stations on the river.

Lift is a transportation device that carries people and freight to the floors of a building. The word *lift* usually means the car in which the people or freight travel. But the term also refers to the entire system that controls the car's movement. The car travels up and down in a shaft that has steel guide rails to prevent movement sideways. In the United States, a lift is called an *elevator*.

The development of lifts led to the construction of skyscrapers. Lifts enabled architects to design taller and taller buildings because people no longer had to climb stairs to reach the upper floors.

Passenger lifts and freight lifts operate in many places and serve a variety of purposes. The passenger lifts commonly seen in office and residential buildings can

Observation lifts have glass sides so that passengers can view their surroundings. These lifts are installed in interior courts, *above,* or along exterior walls.

carry from 900 to 1,800 kilograms. Some freight lifts can carry as much as 45,000 kilograms.

There are more than 2 million lifts in the world, and about 390,000 of them are in the United States and Canada. Lifts in the United States and Canada carry a total of about 350 million passengers daily.

How lifts work. Most lifts operate automatically. Only a few are run by attendants who ride in the cars. A person brings a lift to a certain floor by pushing a button in the wall outside the shaft. The lift doors open automatically after the car arrives at the floor, and they close after the passenger has entered. The passenger pushes a button to indicate the floor where he or she wants the lift to stop. The car stops at all floors where passengers want to be picked up or wish to get out.

Most lifts in buildings of 10 or more floors are powered by *electric traction* systems and are lifted by steel cables. There are two types of electric traction lifts, *gearless traction* and *geared traction.*

Gearless traction lifts are used in office buildings of more than 10 floors and in residential buildings of more than 30 floors. They travel at speeds of 120 to 600 metres per minute. Cables called *hoisting ropes* lift the car. One end of each cable is attached to the top of the car. The other end is connected to a heavy steel counterweight that balances the weight of the car and about half of its maximum passenger load. The counterweight reduces to a minimum the power needed to operate the lift. The hoisting ropes fit around a *sheave* (pulley) that is connected directly to an electric motor. As the sheave turns, the ropes move and the car goes up or down. A brake holds the car in place when the lift stops.

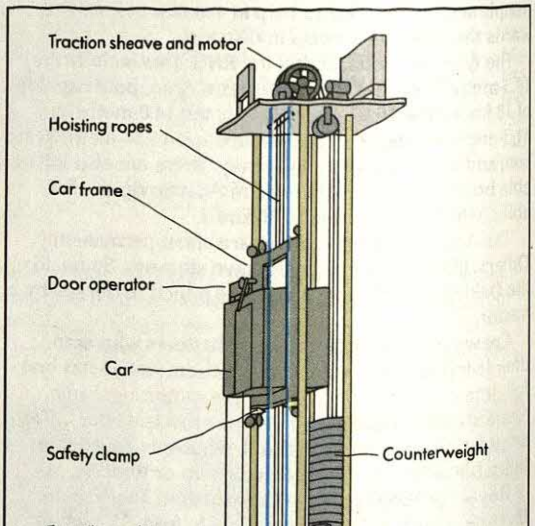
Geared traction lifts travel at speeds as high as 137 metres per minute. Geared traction lifts are similar to the gearless traction type of lift. However, the motor of a geared traction lift operates a *reduction gear,* which turns the sheave. This gear decreases the speed at which the sheave would otherwise turn.

Some lifts, called *hydraulic lifts,* are driven by a hydraulic system. They are lifted and lowered by a long *ram* (piston) instead of by steel cables. Such lifts travel at speeds of 15 to 48 metres per minute. They serve many buildings of six or fewer storeys. The ram rises and lifts the lift when an electric pump forces oil into the ram cylinder. The lift goes down when a valve opens and the oil flows into a storage tank.

Safety features. In many countries, lifts must operate according to safety codes, normally defined by an organization of agencies, including consumer, government, and industrial groups. Officials then inspect the lifts regularly to make sure that all the safety features are functioning.

Passenger lifts are usually expected to have steel doors that can withstand fire. Most lifts have two sets of doors. One set is in the walls at each floor, and the other set is part of the car itself. Both sets of doors must close and lock before the lift can move. A special safety device causes the doors to reopen if someone is in the doorway. If a lift goes too fast as it travels down, safety clamps grab the guide rails and stop the car. All automatic lifts have alarm bells, and some have intercom systems or telephones. Passengers can use these instruments in emergencies, such as to call for help if the lift stops between floors.

Special kinds of lifts. Some large buildings have *double-deck lifts,* which have two compartments and



A gearless traction lift, *above,* has steel cables called *hoisting ropes* that fit around a sheave. When the sheave is turned by an electric motor, the ropes lift or lower the car.

serve two floors with each stop. People who want to go to odd-numbered floors enter the lower compartment of the lift on the first floor. Those people who want even-numbered floors enter on the second floor and ride in the upper compartment. Lifts called *observation lifts* have glass sides and travel along the walls of interior courts or along the outside walls of buildings. Passengers can view the surrounding area through the glass sides.

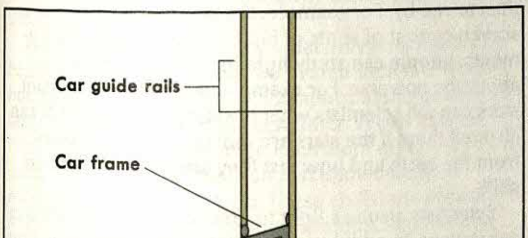
Some tall buildings have express lifts that travel nonstop to certain floors where passengers change to local lifts. The local lifts then carry the people to their floors.

Construction companies use lifts that travel along the outside of buildings and carry crews and building materials. Other kinds of lifts take workers and materials into mines. Hospital lifts are large enough to carry beds and stretchers.

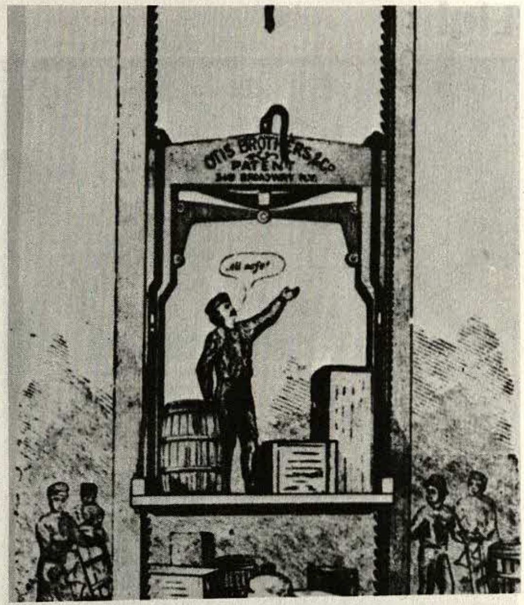
History. The ancient Greek mathematician Archimedes invented a type of lift before 230 B.C. It used ropes and pulleys and could lift one person.

Lifts were in use during the early 1800's. By the 1840's, both hydraulic and steam-powered freight lifts had been invented. But the hydraulic lifts were very slow, and the ropes of the steam-powered lifts often broke and the cars fell.

In the early 1850's an American, Elisha G. Otis, invented the first lift that had an automatic safety device. If the rope broke, the device prevented the lift from falling. Otis first demonstrated the lift in 1854. The world's first lift designed specifically for passenger use was installed in New York City in 1857. The world's first electric lift started operating in 1889.



A hydraulic lift, *above,* is lifted and lowered by a *ram* (piston). The car rises when a pump forces oil into the ram cylinder. The car descends when the oil flows into a storage tank.



The first lift with a safety device was demonstrated by Elisha G. Otis in 1854. The automatic device prevented the lift from falling if the hoisting rope broke.

Automatic lifts were introduced in residential buildings in the 1890's. Attendants operated the lifts in major office buildings until 1950. That year, an office building in Dallas, Texas, U.S.A., became the first to have automatic lifts.

See also **Otis, Elisha G.**

Lift. See **Aerodynamics** (Lift).

Lift pump. See **Pump.**

Ligament is fibrous tissue that holds organs of the body in place and fastens bones together. Ligaments are grouped together in cords, bands, or sheets. They are as strong as rope. A *sprain* occurs when ligaments covering a joint are torn or twisted. A sprained ankle is the partial tearing of the ligaments that bind the bones of the lower leg to the bones of the foot. Ligaments heal slowly. They may never heal if they are completely torn apart. Treatment of sprained ligaments may include exercise, supportive bandages or splints, or even surgery, depending on the ligaments involved and the severity of the injury. See also **Sprain; Human body** (picture: Ligaments and tendons).

Ligature is a thread used in surgery to tie a bleeding blood vessel. Surgeons did not use ligatures extensively until germfree surgery developed in the mid-1800's. Before that time, ligatures almost always caused infection. The British surgeon Joseph Lister devised a sterile ligature, called *catgut,* from a sheep's bowel. The body absorbs this material without harm. Surgeons also use silk, cotton, linen, and nylon ligatures. These are not absorbed, but are not harmful.

Liger. See **Lion.**

Light

Light from the sun makes life on earth possible. Plants need sunlight to grow, and animals eat plants or plant-eating animals.

Light is so common that we often take it for granted. Yet the world would quickly change if suddenly there were no light. We could no longer see, because light that comes to our eyes makes seeing possible. Without light, we would have no food to eat or air to breathe. Green plants use the light from the sun to grow and to make food. All the food we eat comes from plants or animals that eat plants. As plants grow, they give off oxygen. This oxygen is a necessary part of the air we breathe.

Light gives us fuels. The energy in the sunlight that shone on the earth millions of years ago was stored by plants. After these plants died, they were changed into coal, natural gas, and oil. Today, we use the energy in these fuels to produce electricity and to operate machines.

Light from the sun also heats the earth. Without the sun's light, the earth would soon become so cold that nothing could live on it. Even if we burned all our fuels, we could not keep the earth warm enough for life to exist. For more information on light and energy from the sun, see the *World Book* articles on **Solar energy** and **Sun.**

People have found ways of making and controlling light in order to see when there is no sunlight. At first, they produced light with campfires and flaming torches. Later, they developed candles, oil lamps, gaslights, and electric lights.

People make and use light for many other purposes than to see by. For example, the pictures on a television screen consist of spots of light. Using scientific instruments, people can study light itself and learn much about the universe. For example, the light from distant stars can tell scientists what the stars are made of. It can also tell them if the stars are moving toward or away from the earth and how fast they are moving. See **Red shift.**

Scientists also use light to identify and study chemical substances. In addition, light is used for communication. Optical cables transmit information in the form of light over long distances. They are increasingly replacing the copper wires used by telephone companies. Scientists are now experimenting with light as a carrier of information inside very fast central processors of computers. See **Fibre optics.**

What is light? This question has been a puzzle for centuries. People once thought light was something that travelled from a person's eyes to an object and then back again. If anything blocked the rays from the eyes, the object could not be seen. They argued also that light needed a medium, which they called the *ether,* to travel through space. Since the 1600's, scientists have made many discoveries about light. They have learned that light is a form of energy that can travel freely through space. The energy of light is called *radiant energy.* There are many kinds of radiant energy, including infrared rays, radio waves, ultraviolet rays, and X rays. We can see only a tiny part of all the different kinds of radiant energy. This part is called *visible light* or simply *light.*

This article describes where light comes from, the nature of light, and how light behaves when it comes in contact with various materials. The article also tells how light is measured and discusses the important scientific discoveries about light.

Sources of light

Light makes it possible for us to see. Many of the things we see, such as the sun and room lights, are *sources* of light. We see all other things because light from a source bounces off them and travels to us. Light sources can be classified as *natural* or *artificial.* Natural light comes from sources that we do not control. Such sources include the sun and the stars. Artificial light comes from sources that we control. These sources include candles and car lights.

How light is produced. All light comes from atoms. It is produced by atoms that have gained energy either by absorbing light from another source or by being struck by other particles. An atom with such extra energy is said to be *excited.* Ordinarily, an atom stays excited only briefly. It de-excites by giving up its extra energy. It can either run into another atom to lose the energy, or it can *emit* (give off) light. The light then carries away the extra energy. The amount of energy needed to excite atoms and the amount of energy the atoms emit as light varies for different kinds of atoms.

Light is usually described as a wave, shaped much like a water wave that moves across a lake. But light can also be described as a small particle, called a *photon.* Each photon moves in a straight line, much as a pool ball does. In both descriptions, the light has energy. The amount of energy that is carried by the wave or photon largely determines the colour of the light. For example, suppose you see a red apple on a blue chair. Each photon from the apple has less energy than a photon from the chair.

One way to excite atoms so that they emit light is by heating them. A poker may be heated until it is white-hot. Because of the heating, the atoms at the poker's surface collide violently with each other. When they collide, they excite one another. Each atom quickly emits its extra energy as light but is almost immediately re-excited by another collision. These collisions produce such a variety of states among the atoms that the photons released have a wide range of energies. The combination of all the resulting colours is white light. As the poker cools, fewer atoms are excited to high energies, and so the atoms emit fewer photons with the higher energies of blue light. Since red light is still being emitted, the cooling poker looks red.

Other sources of light. Many substances gain energy and emit light without being heated very much. They do this through a process called *luminescence.* Some luminescent materials glow in the dark long after they have received extra energy. They are said to be *phosphorescent.* Their atoms stay excited for some time before they de-excite and emit light. Certain phosphorescent materials are used in the markings that glow on watch faces (see **Phosphorescence**). Other luminescent materials emit light only during their exposure to exciting energy. They are said to be *fluorescent* (see **Fluorescence; Fluorescent lamp**).

Fireflies and a few other types of organisms emit light by a process called *bioluminescence.* In this process, chemicals within the organisms combine to produce a different chemical that has excited atoms. When the atoms de-excite, they emit photons.

The sun shines because nuclear reactions between hydrogen atoms within its core produce a tremendous amount of energy. Photons and other kinds of particles carry the energy to the sun's surface. At the surface, these particles excite atoms that then de-excite by emitting light. The earth receives part of that light. All stars emit light by this process.

An *aurora* such as the northern lights is an emission of light by molecules of air. When high-speed particles arrive at the earth from large eruptions on the sun, they crash into the air molecules. These collisions excite the molecules with extra energy. The molecules then release the energy by giving off light. When the collisions occur at night, the light emitted may be bright enough to be seen.

A *laser* is a device that produces a powerful, narrow beam of light in which all the photons have the same energy and travel in the same direction. Lasers serve as tools in scientific research, surgery, and telephone communications. They also have many industrial and military uses.

Natural and artificial sources of light

Natural light sources, such as auroras and fireflies, are not controlled by people. People control artificial light sources, such as candles and lasers. All light comes from atoms.

Aurora

Firefly

Candle

Laser

The nature of light

During most of the 1800's, scientists thought of light as a wave that travels much like a water wave. This idea of light as a wave was popular because it explained experiments in which light created a series of bright and dark lines called an *interference pattern.* Scientists could explain such interference patterns only by describing light as a wave.

If light is a wave, then what waves? Water waves are easier to explain. They travel across the surface of the water while the water itself only moves up and down. To scientists of the 1800's, light seemed stranger than water waves because it travels through space from the sun and other stars to the earth. They assumed that light waves must also travel through some kind of material, just as water waves travel through water. Although scientists had no evidence of this material, they called it the *ether.* By the late 1800's, scientists had concluded that light waves consist of regions of force known as *electric fields* and *magnetic fields.*

A simple model of a light wave begins with a *ray* (a straight line) that shows the direction of the light's travel. Along the ray and *perpendicular* (at right angles) to it, short arrows represent the electric field. Some arrows point upward from the ray and other arrows point downward from it. They vary in length so that the overall pattern of the tips of the arrows looks like a wave. Arrows representing the magnetic field also resemble a wave, but these arrows make right angles to the arrows that represent the electric field. These patterns move along the ray. They are the light.

By the early 1900's, experiments had shown that scientists finally had to give up the idea of an ether. Many scientists realized that a wave of light, as a regularly varying pattern of electric and magnetic fields, can travel through empty space.

Light waves resemble other types of waves in some features, including *wavelength, frequency,* and *amplitude.* The wavelength is the distance along a straight line from one *crest* (peak) of the wave to the next. The frequency of a wave is the number of times each second that crests pass a stationary checkpoint. The amplitude of a wave is the greatest distance of a crest or *trough* (low point) from the ray.

A simple relation exists between a wave's frequency and wavelength: the higher the frequency, the shorter the wavelength. A wave's energy corresponds to its amplitude. The greater the amplitude, the more energy the wave has. The energy of a light wave also corresponds to its frequency. The wavelength determines the colour of the light.

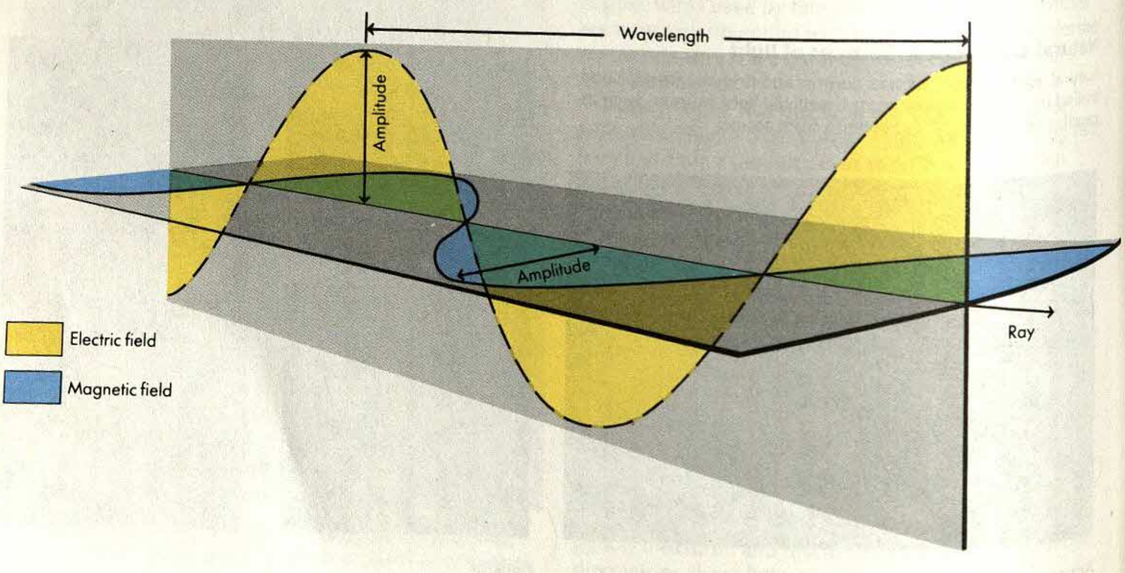
Photons. In 1905, the German-born physicist Albert Einstein proposed a model of light just as useful as the wave model. In some experiments, light behaves as though it is a particle. We now call this type of particle a photon. In Einstein's model, a ray of light is the path taken by a photon. For example, when a lamp sends a beam of light across a dark room, the beam of light consists of a great many photons, each travelling in a straight line.

Is light a wave or a particle? Seemingly, it cannot be both because the two models are so different. The best answer is that light is strictly neither. In some experiments light behaves like a wave, and in others it behaves like a particle.

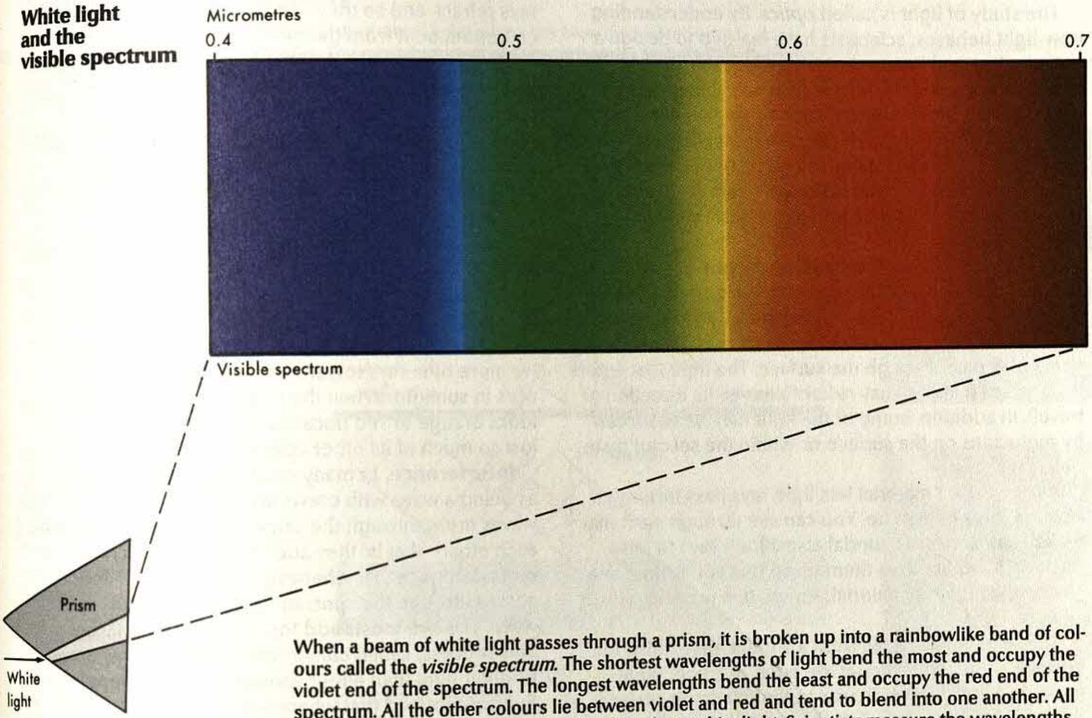
Unlike other kinds of waves, light waves in a vacuum have one speed, and that speed is the fastest that anything can travel. Scientists do not understand why this is true. The fact that light in a vacuum has only one speed forms one of the foundations of Einstein's theory of relativity (see **Relativity** [Special theory of relativity]).

Electromagnetic nature of light

Light is a kind of electromagnetic wave. Such a wave consists of an electric field and a magnetic field. These fields are at right angles to each other and to the direction of the wave's travel. The wave's *amplitude* is its greatest distance from the ray.



White light and the visible spectrum



When a beam of white light passes through a prism, it is broken up into a rainbowlike band of colours called the *visible spectrum.* The shortest wavelengths of light bend the most and occupy the violet end of the spectrum. The longest wavelengths bend the least and occupy the red end of the spectrum. All the other colours lie between violet and red and tend to blend into one another. All the colours in the spectrum mixed together form white light. Scientists measure the wavelengths of light in units called *micrometres.* One million micrometres equals one metre. Light we can see has wavelengths from about 0.4 to 0.7 micrometre. The bending of the light as it passes through the prism has been exaggerated in the illustration to magnify the spectrum.

When light enters a material, it continually runs into atoms that delay its travel. But between atoms, light travels at its normal speed.

Electromagnetic waves. Because light consists of electric and magnetic fields, it is called an *electromagnetic wave.* The term *light* commonly refers to just those electromagnetic waves that we can see. For light to be visible, it must have a wavelength within a certain narrow range of values called the *visible spectrum.* Violet light has the shortest wavelength that is visible. Red light has the longest. Between them lie all the other colours of the spectrum, each with its own wavelength. Seen together at the same time, the colours appear as white light. Sunlight is white because it has all the colours. However, when it passes through a specially shaped transparent solid called a *prism,* the different colours separate and can be seen.

The visible spectrum forms only a small part of the full range of electromagnetic waves. Waves that have wavelengths slightly too short to be seen are called *ultraviolet rays.* They cause suntan, sunburn, and skin cancer. Waves with somewhat shorter wavelengths than ultraviolet rays are called *X rays.* These rays can penetrate a person's body. Doctors and dentists use them to "see" inside the body. *Gamma rays* have even shorter wavelengths than X rays. They result from nuclear reactions, such as those in the sun.

Waves with wavelengths slightly longer than those of red light are called *infrared rays.* When you stand in bright sunlight or in front of a fire, you feel warm largely because of the infrared light shining on you. *Microwaves* and *radio waves* have longer wavelengths than infrared waves. A microwave oven shines microwaves on food to warm it. A police officer's radar unit shines microwaves onto an approaching car to measure its speed. Radio and television stations broadcast programmes by sending radio waves.

Sunlight spread into its different colours by a prism creates a *continuous spectrum.* From violet to red, the spectrum blends smoothly from one colour to the next. Many other sources of light do not produce a continuous spectrum. For example, a street lamp may produce bright yellow, blue, and a few dimmer colours, but it also has dark regions in its spectrum. The colours are produced by certain atoms in the gas inside the lamp. For example, the yellow comes from sodium atoms. Each type of atom can produce only certain colours.

Scientists can learn what kinds of atoms make up a light source by observing what colours are present in the light. They direct the light through an instrument called a *spectrometer* to separate the colours. The spectrometer may be a simple prism or it may be a more complicated device.

Sometimes a spectrum contains gaps because the light from a source has travelled through a gas that absorbed certain colours. For example, when sunlight is sent through a high-quality spectrometer, its spectrum has thousands of such gaps. The light produced within the sun must travel through the outer atmosphere of the sun to reach the earth. Each type of atom in the sun's atmosphere absorbs certain colours. By noting which colours are removed, scientists are able to determine what kinds of atoms are in the atmosphere of the sun. See **Spectrometer.**

How light behaves

The study of light is called *optics.* By understanding how light behaves, scientists have learned to design a variety of optical instruments that aid in the study of the universe. For example, microscopes enable us to examine extremely small objects, such as single-celled organisms. With telescopes, we can observe distant but very large objects, such as galaxies and planets. Optics also enables us to understand vision, the colours of the sky, the sparkle of a diamond, and many other parts of the everyday world.

Reflection, refraction, and absorption. When a ray of light reaches a surface between two types of materials, such as air and glass, several things can happen. Some of the light may reflect from the surface, while some may pass through the surface. The light that enters the second material may *refract* (change its direction of travel). In addition, some of the light may be *absorbed* by molecules on the surface or within the second material.

A *transparent* material lets light rays pass through it without mixing them up. You can see through such material. A *translucent* material also allows rays to pass through it, but it mixes them up so that you cannot see clearly through the material. An *opaque* material blocks all light.

The reflection of a ray from a surface resembles the bounce a pool ball takes at the edge of a pool table. Imagine a line perpendicular to the reflecting surface. Such a line is usually called the *normal.* The angle between the path of an incoming ray and the normal is called the *angle of incidence.* The reflected ray makes the same angle to the normal as the incoming ray, but on the other side of the normal. Reflection works this way even when it involves rough surfaces. Wherever a ray reflects from a surface, it has an equal angle to the normal at that spot as it had before the reflection.

When light reflects from a smooth surface, all of its rays reflect in the same direction. When light reflects from a rough surface, the rays reflect in many directions because the normals at all spots on the surface point many ways. Thus, you can see your image in a mirror, but you cannot see your image in a sheet of writing paper. See **Reflection.**

When light passes through a surface, its speed changes. This happens because the light must travel through a different kind of molecule than it passed through before. For example, if light passes from air into glass, it slows because the glass molecules are more densely packed than the air molecules. If the light enters at any angle except a right angle, the change in the light's speed changes its direction of travel. In other words, the light refracts.

When a ray passes from air into glass, it bends towards the normal at the surface. The amount of bending depends partly on the type of material the ray enters. Different types of glass and plastic refract light by different amounts. Diamond refracts light much more than either glass or plastic does.

To observe refraction, place a pencil in a glass of water and then look at the pencil from the top and one side. The pencil appears bent at the water surface. The light from the top part of the pencil comes directly to your eyes. The rays from the bottom part pass through the surface between the water and the air. There the rays refract, and so they seem to have come from a pencil bottom bent from the pencil top. See **Refraction.**

Opaque materials absorb certain colours of light. For instance, a red book cover exposed to white light looks red because molecules on its surface absorb all the other colours in the light. The energy of the absorbed light quickly changes to heat, warming the surface. Transparent materials also absorb certain colours if they contain dyes or pigments.

Scattering describes what happens when light rays strike atoms, molecules, or other individual, tiny particles. These particles send the rays of light off in new directions—that is, they cause the rays to *scatter.* Most of a clear sky appears blue because air molecules scatter more blue rays toward us than they do the other colours in sunlight. When the sun is near the horizon, it looks orange or red because the light reaching us has lost so much of its other colours by scattering.

Interference. In many cases, light can be thought of as being a wave with crests and troughs. When two light waves cross through the same spot, they *interfere* with each other—that is, they add to or subtract from each other. Suppose that whenever a crest of one wave passes through the spot, so does a crest of the other wave. The two crests add together to give a larger crest. This process, called *constructive interference,* gives brighter light than either wave would have separately. Suppose instead that whenever a crest of one wave crosses through the spot, a trough of the other wave also does. The trough reduces the height of the crest, leaving the spot dim or even dark. This process is called *destructive interference.*

The fact that light can interfere to produce brightness or darkness provides the strongest argument for the wave model of light. All types of waves can produce a pattern of constructive and destructive interference when they pass through two small, nearby openings.

In the early 1800's, the English scientist Thomas Young showed the wave nature of light by sending a light beam through two narrow slits. The light that emerged from the slits then reached a screen. If light were not a wave, only two narrow, bright strips of light—one from each slit—would have appeared on the screen. But, in fact, the light emerging from each slit spread and overlapped the light emerging from the other slit. This light filled the screen with bright and dark lines called *fringes.* Bright fringes occurred where the two waves arrived crest-on-crest to give constructive interference. Dark fringes occurred where the two waves arrived crest-on-trough to give destructive interference. See **Interference.**

Diffraction. In Young's experiment, the light passing through each slit spread. This type of spreading is called *diffraction.* Like interference, it results from the fact that light behaves as a wave. A light wave spreads slightly when it travels through a small opening, around a small object, or past an edge. Water waves also spread, but the openings and objects that cause them to spread must be much larger than those for light.

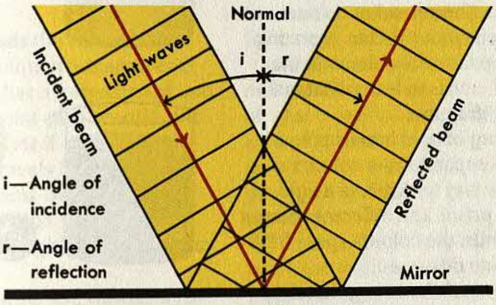
Diffraction of light can be a nuisance. Suppose you attempt to see a very small object by using a high-quality microscope. As you increase the magnifying power to see the object more and more closely, the object's edges begin to blur. Each edge blurs because the light

The behaviour of light

In studying *optics* (the science of the behaviour of light), physicists have discovered certain principles that describe how light behaves. The most important of these principles include (1) reflection, (2) refraction, (3) diffraction, and (4) interference.

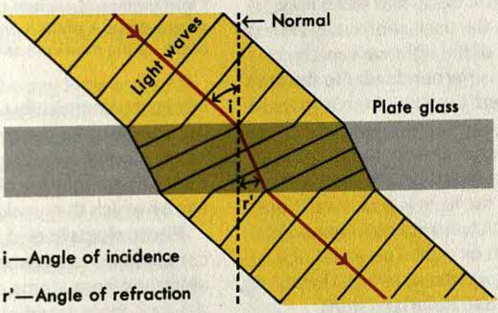
Reflection

A beam of light will be reflected by a smooth surface. The beam coming toward the surface is called the *incident beam.* After the beam has been reflected, it is called the *reflected beam.* The angle the incident beam makes with an imaginary line *normal* (at right angles) to the surface equals the angle made by the reflected beam.



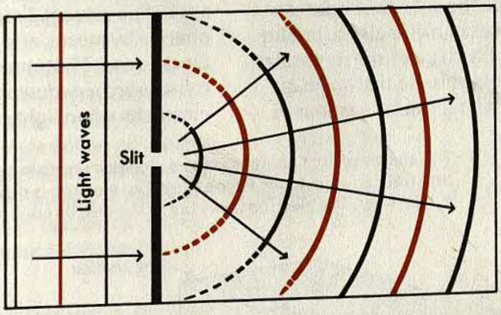
Refraction

Refraction causes a beam to bend as it passes from one substance into another. The beam bends toward the normal if it slows down when entering a substance, as shown in the diagram. The *angle of refraction* then is less than the *angle of incidence.* If light travels faster in the substance, the beam bends away from the normal.



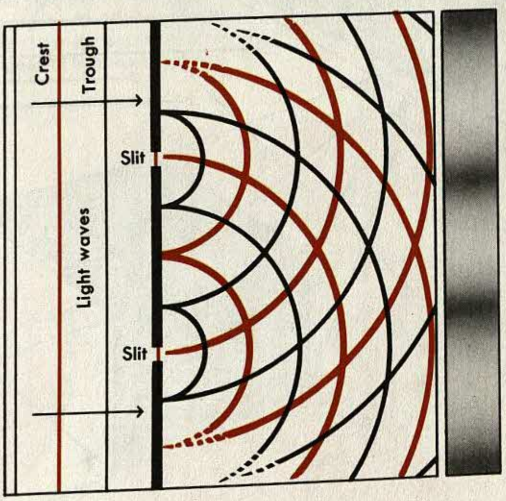
Diffraction

Light and other waves usually travel in a straight line. But when waves pass through a slit about the same size as their own wavelength, they *diffract* (spread out) into curving waves. The photograph shows water waves because light waves spread out so slightly that their diffraction is difficult to see.



Interference

Light waves can interfere with each other in two ways. (1) Where the *crest* (peak) of one wave meets the crest of another—or where the *trough* (low point) of one wave meets the trough of another—the two waves combine and form a bright spot of light. This process is called *constructive interference.* (2) Where a crest meets a trough, the two waves cancel, leaving a dark spot. This process is called *destructive interference.* The photograph shows the interference pattern of water waves produced by two sources.



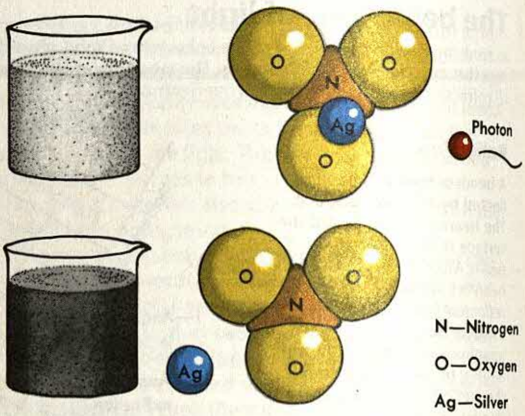
passing by the edge on its way to the eye diffracts.

However, diffraction serves a purpose when a device called a *diffraction grating* is used to study the colours in a light beam. The grating consists of thousands of thin slits that diffract light. Each colour in the light diffracts by a slightly different amount. The spread of colours can be large enough to make each colour visible. A grating used with a telescope can separate the colours in the light from a star, enabling scientists to learn what materials make up the star. See **Diffraction.**

Dispersion is the spreading of light into its colours. The dispersion of white light separates the colours of the full visible spectrum. One way to disperse a light beam is to send it through a prism. The different colours refract to different extents. Thus, the colours spread. Diffraction and scattering can also disperse light.

Polarization involves the *oscillations* (regular variations in strength) of the electric fields that make up a light wave. The directions of the oscillations may be represented by arrows. In most of the light we see, the arrows point in many directions perpendicular to the ray's path. Such light is *unpolarized.* But few of the arrows remain when light passes through certain types of sunglasses, reflects from surfaces at certain angles, or scatters from air molecules. If these arrows all point in one direction or just opposite it, the light is *polarized.* Suppose that when sunlight reflects from a road to you, its arrows point only to your left or right. You can block it by wearing sunglasses with *polarizing filters.* They block light oscillating left or right. See **Polarized light.**

Chemical effects of light. The energy of light can chemically change the surfaces of materials absorbing it. For example, light chemically changes the molecules of silver grains on photographic film so that an image can be recorded on it. Strong light can fade coloured fabrics by chemically changing their dyes. Light changes the chemistry of the eye's *retina,* so that the retina produces signals about sight (see **Eye** [The retina]). Green plants need light for *photosynthesis,* the chemical process by which they make food (see **Photosynthesis**).

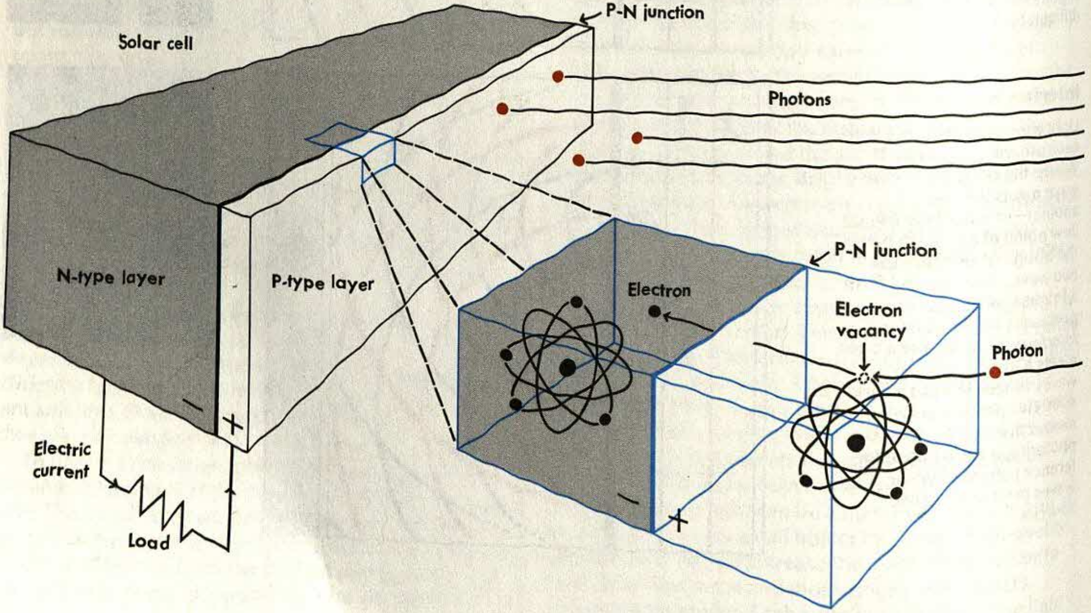


Light causes chemical changes in some substances, such as silver nitrate. A photon, *top,* provides the energy needed to break up the molecule and turn the solution dark, *below.*

Photoelectric and photoconductive effects. When certain materials absorb light, the light's energy frees electrons from atoms on the materials' surface. In some devices, these freed electrons can flow through a circuit as electric current. Solar cells and other electric eyes operate by means of such photoelectric effects (see **Electric eye; Photomultiplier tube**). Some materials called *photoconductors* become better conductors of electricity when light shines on them.

Photoelectric effect of light

The energy of light photons creates electric current in a solar cell. A photon releases an electron from an atom in the P-type layer. The electron is driven across the P-N junction into the N-type layer. The electron flows out of the cell, through a load, and back to the P-type layer.



Measuring light

Scientists measure wavelengths of light in a variety of metric and imperial units. One common metric unit is the *micrometre,* which equals 0.000001 metre. The wavelengths of light in the visible spectrum range from about 0.4 micrometre for deep violet to about 0.7 micrometre for deep red.

The frequency of any wave equals the ratio of the wave's speed to its wavelength. Frequencies are measured in units called *hertz.* A wave has a frequency of one hertz if one crest passes a checkpoint each second, and the wave has a frequency of 100 hertz if 100 crests pass a checkpoint each second. Light travels in a vacuum at nearly 300 million metres per second. Because visible light has a short wavelength and a high speed, it has a high frequency. For example, violet light has a frequency of 750 million million hertz.

The brightness of light. Scientists use various units to measure the brightness of a light source and the amount of energy in a beam of light coming from that source.

The amount of light produced by any light source is called the *luminous intensity* of that source. The standard unit used to measure luminous intensity is the *candela.* For many years, the luminous intensity produced by a certain size candle made from the oil of sperm whales served as the standard. The unit was called a *candle.* However, the sperm whale candle did not provide an easily used standard for the measurement of light. One candela is now defined as the amount of light given off by a source emitting at a specific frequency (540 million million hertz) and at a specific intensity ($\frac{1}{683}$ watt per unit of area called a *steradian*).

The intensity of a light source in candelas does not indicate how bright the light will be when it reaches the surface of an object, such as a book or a desk. Before we can measure *illuminance* (the light falling on a surface), we must measure the light travelling through the space between the source and the object. We can measure a beam of light with a unit called the *lumen.* To see how the lumen is measured, imagine a light source placed at the centre of a hollow sphere. On the inside surface of the sphere, an area is marked off equal to the square of the radius of the sphere. For example, if the radius is 1 metre, the area marked off is 1 square metre. If the light source has a luminous intensity of 1 candela, the marked area will receive a *luminous flux* (rate of light falling on it) of 1 lumen.

In the metric system of measurement, engineers measure illuminance in units called *lux.* An illuminance of 1 lux is produced by 1 lumen of light shining on an area of 1 square metre. The imperial system uses a unit called the *foot-candle.* An illuminance of 1 foot-candle is produced by 1 lumen of light shining on an area of 1 square foot.

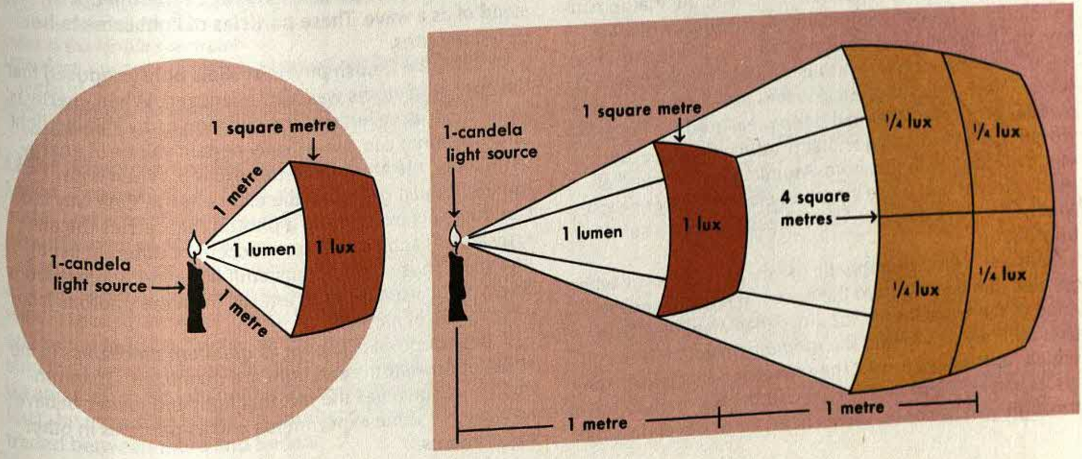
The intensity of light falling on a surface varies *inversely* (oppositely) with the square of the distance between the source and the surface. That is, if the distance increases, the illuminance decreases by the square of the distance. This relationship is called the *inverse square law.* If a surface that receives 1 lux of light at a distance of 1 metre from a source is moved 2 metres from the source, that surface will then receive $(\frac{1}{2})^2$, or $\frac{1}{4}$, lux of light. This happens because light spreads out from its source.

The speed of light. Although light seems to travel across a room the instant a window blind is raised, it actually takes some time to travel any distance. The speed of light in empty space—where atoms do not delay its travel—is 299,792 kilometres per second. This speed is said to be *invariant* because it does not depend on the motion of the light's source. For example, light that is emitted by a moving torch has the same speed as light that is emitted by a stationary torch. Scientists do not know why this is true, but the fact is one of the foundations of Einstein's theory of relativity.

From ancient times, people argued about whether the speed of light is limited or infinite. During the early 1600's, the Italian physicist Galileo devised an experiment to measure the speed of light, and so settle the argument.

Basic units of light measurement

A *1-candela* light source, *left,* inside a 1-metre-radius sphere illuminates every square metre of the sphere's surface with 1 *lumen* of light. One lumen falling on a 1-square metre area, *right,* illuminates it with 1 *lux.* Because light spreads as it travels, a surface 2 metres from the light source receives 1 lumen of light spread over 4 square metres, or $\frac{1}{4}$ lux.



Galileo sent an assistant to a distant hill with instructions that the assistant should open the shutter of a lantern when he saw Galileo on another hill open the shutter of his lantern. Galileo reasoned that because he knew the distance between the hills, he could find the velocity of light by measuring the time between opening his shutter and seeing the light of the second lantern. Galileo's thinking was sound, but the experiment failed. The velocity of light is so great that he could not measure the short time involved.

About 1675, the Danish astronomer Olaus Roemer came upon evidence which proved that light travels at a *finite* (limited) speed. While working in Paris, Roemer observed that the intervals between the disappearance of some of Jupiter's moons behind the planet varied with the changing distance between Jupiter and Earth. Roemer realized that the finite velocity of light caused these differing intervals. Roemer's observations indicated that light travelled at a speed of 226,000 kilometres per second. This figure was within 25 per cent of the actual velocity.

In 1926, the American physicist Albert A. Michelson made one of the first precise measurements of the velocity of light. He used a rapidly rotating mirror that reflected a beam of light to a distant reflector. The returning beam was then reflected back to the observer by the rotating mirror. Michelson adjusted the speed of the mirror until the mirror turned to the correct angle during the time the light travelled to the reflector and back. The speed of the mirror indicated the velocity of the light. Michelson actually used several mirrors on a drum so that the angle the drum had to turn while the light travelled out and back was small. He measured the speed of light at 299,796 kilometres per second. This measurement had a probable error of less than 4 kilometres per second.

Our understanding of light

Early ideas about light. The understanding of light has developed mainly since the 1600's. In 1666, the English scientist Sir Isaac Newton discovered that white light is made up of all colours. Using a prism, he found that each colour in a beam of white light could be separated. Newton proposed the theory that light consists of tiny particles that travel in straight lines through space. He called these particles *corpuscles,* and his theory became known as the *corpuscular theory.*

About the same time that Newton proposed his theory of light, the Dutch physicist and astronomer Christiaan Huygens suggested that light consists of waves. He proposed the *wave theory* to explain the behaviour of light. The corpuscular and wave theories appear to be completely opposite, and scientists argued about them for about 100 years. Then, in the early 1800's, the English physicist Thomas Young demonstrated the interference of light. He showed that two light beams cancel each other under certain conditions. Water waves also behave this way. Because it is hard to understand how interference could occur with particles, most scientists accepted Young's experiment as proof of the wave theory of light.

The electromagnetic theory. In 1864, the British physicist James Clerk Maxwell proposed the mathematical theory of electromagnetism. According to this theory, the influence that changing electric fields and magnetic fields have on one another allows for the travel of waves. Maxwell's theoretical waves had the exact mathematical properties that had been measured for light. The vibrating electric charges that produce light are the electric charges in the atom. Atomic physicists had already shown that these vibrating electric charges exist. Maxwell's work gave the wave theory of light a solid foundation.

Maxwell's electromagnetic theory also did away with an idea that had stood in the way of scientists' acceptance of the wave theory for more than a century. Scientists felt they had to find the *medium* (material) through which light waves travel. They reasoned that if light travels as waves, there must be something for them to travel through, just as sound waves need air to travel through. But for light, this something could not be matter, because light can travel in a vacuum. To get around this difficulty, scientists suggested that the medium light travelled through was the ether.

All attempts to observe or measure the properties of the ether failed. Scientists became increasingly convinced that the ether did not exist. Experiments conducted by Albert Michelson and the American physicist Edward Morley in 1887 helped destroy the ether theory.

Quantum mechanics. In 1900, the German physicist Max Planck discovered an equation that matched experimental data about the emission of light by a hot surface. Planck could not explain why the equation worked. But he realized that it predicted that the tiny emitters of light on the surface can have only certain values of energy. When energy is restricted to certain values, it is said to be *quantized.*

In 1905, Einstein revealed that light itself is quantized. Einstein reasoned that if light emitters can have only certain values of energy, then the energy they emit as light will retain its quantized character. The light comes in tiny packets of energy that are known as *quanta.* The concept of light as quantized energy explained how light behaves as a particle in certain experiments, instead of as a wave. These particles of light came to be called photons.

In 1913, the Danish physicist Niels Bohr proposed that the energy of atoms was also quantized. When energy is given to an atom, either by a collision or by shining light on it, the atom can accept only certain values of energy. In this way, the atom becomes excited. When it de-excites, it must get rid of the extra energy. One way it can do this is by emitting a photon that carries the energy away. Each type of atom accepts a different set of energies. Thus, when atoms emit light, the photons from one type of atom differ in energy from the photons from other types of atoms.

A field of physics known as *quantum mechanics* is the study of how atoms and light are quantized. Quantum mechanics involves the fact that light and matter behave as waves in some experiments and as particles in other experiments.

Study aids

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Huygens, Christiaan
Maxwell, James Clerk
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Photomultiplier tube
Photosynthesis
Polarized light
Quantum mechanics
Rainbow
Reflection
Refraction
Shadow
Spectrometer
Sun
Telescope
Ultraviolet rays
Waves
Zeeman effect

Outline

I. Sources of light
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  B. Other sources of light
II. The nature of light
  A. Photons
  B. Electromagnetic waves
III. How light behaves
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  B. Scattering
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IV. Measuring light
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V. Our understanding of light
  A. Early ideas about light
  B. The electromagnetic theory
  C. Quantum mechanics

Questions

What colour is the light with the longest wavelength that is visible?
What are *photons*?
Why is light strictly neither a wave nor a particle?
What property of a light source is measured in lumens?
What is *diffraction*? *Interference*? *Polarization*?
How does the heating of atoms cause them to give off light?
Why did scientists suggest that light travelled through a medium called the *ether*?
What is the *visible spectrum*?
Why does a pencil in a glass of water appear bent at the water surface?
What theory did the British physicist James Clerk Maxwell propose that strengthened the wave theory of light?

Light, Electric. See **Electric light.**

Light, Francis (1740-1794), was a pioneer English trader and adventurer who played a key role in the British settlement of Malaya.

Francis Light was born in Suffolk, England. He served as a midshipman in the Royal Navy during England's war with France in the early 1760's. In 1765, he left the navy and sailed to India. There, he commanded a merchant ship for a firm in Madras. In 1771, Light sailed to Sumatra and then to Kedah, on the Malay Peninsula. A year later, he moved to Phuket in southern Thailand, and traded between there and Kedah.

Light learnt to speak Malay and Siamese (Thai). He soon won the favour of Thai officials, and even that of the king of Thailand. He was also highly regarded by Sultan Muhammad Jiwa, the ruler of Kedah. As a result, he was able to negotiate a treaty with the sultan, allowing the British East India Company to establish a trading settlement on the island of Penang. Light was appointed superintendent of the new settlement. He held this post until his death from malaria in 1794.

Light, Invisible. See **Ultraviolet rays.**

Light, William (1786?-1839), was the founder and planner of Adelaide, Australia. When the British government agreed to the colonization of South Australia, the South Australian Commissioners appointed Light as their surveyor general. They instructed him to select a suitable site, plan a town, and survey the surrounding land for farms and roads. He explored Gulf St. Vincent and finally selected the site for Adelaide about 10 kilometres inland from Holdfast Bay. Colonists criticized him for his selection of the site because they considered it to be too far inland. They also criticized him for not surveying sufficient farm land, even though his staff was inadequate for the job.

William Light

In 1838, Light resigned after a disagreement with Governor Hindmarsh. His temporary dwelling was burned down, and he moved into his uncompleted house, which he called *Thebarton,* after the county of Suffolk in England where he had spent part of his early life. He was buried under William Light Square.

Light was born in Kedah in Malaya and spent his early years in Penang. He was educated in England and joined the navy in 1794.

Light bulb. See **Electric light; Edison, Thomas.**

Light lists. See **Lighthouse** (Identifying lighthouses).

Light meter is an instrument used to measure the brightness of light. Light meters serve a variety of specialized needs. For example, astronomers use them to measure the brightness of stars. Lighting engineers use them to measure the brightness of lighting in homes and offices. Photographers use them to measure the intensity of light in scenes they wish to photograph.

Most light meters include a photo cell made of cadmium sulphide or gallium arsenide. The cell, which is attached to a battery, resists the flow of electric current from the battery by an amount that depends on the brightness of the light. The current is measured by a current meter. When brighter light falls on the cell, the resistance decreases. More current is thus allowed to flow, producing a larger reading on the current meter.

A less sensitive type of light meter uses a cell of selenium. When light shines on it, the cell produces a small voltage, which is measured by a voltage meter. The voltage and the meter reading increase with the brightness of the light.

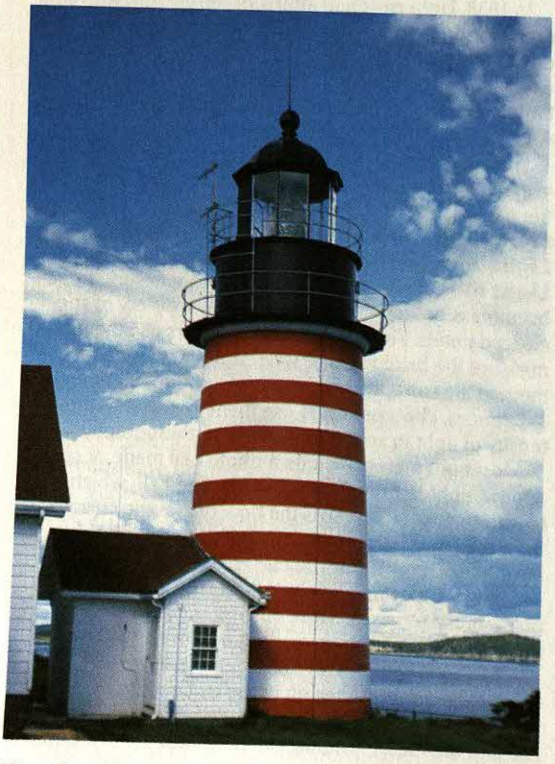
The brightness of light can be expressed in terms of lumens, luxes, foot-candles, or other units. Many photographers' meters measure brightness in arbitrary units chosen by the meter's manufacturer. For convenience, such units correspond to exposure settings on a photographer's camera.

Many cameras feature built-in light meters. Such light meters measure the amount of light entering the camera lens from a narrow range of angles in front of the camera. When the camera points toward an object that reflects light well, the meter registers bright light and so indicates the need for a short exposure. If the rest of the scene is dim, however, the picture may be badly exposed. For this reason, most professional photographers prefer to use a separate light meter that can be directed at the source of light. Such meters are better indicators of the appropriate exposure setting for a scene because they measure the light that illuminates the scene as a whole rather than the light reflected by individual objects.

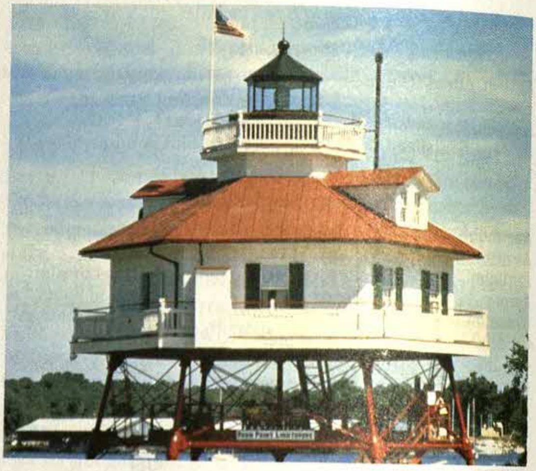
See also **Candela; Foot-candle; Lighting; Photography** (Exposure meters).

Light switch. See **Electric switch.**

Light-year is a unit used by astronomers to describe the distance to and between stars. It is the distance travelled in one year by a pulse of light. Light travels at 299,792 kilometres per second. One light-year therefore equals 9.46 million million kilometres. A jetliner travelling at a speed of 800 kilometres per hour would need to fly for 1.34 million years in order to travel one light-year. Astronomical distances are so great that even the star nearest to the earth—other than the sun—is 4.3 light-years away. See also **Astronomy** (Stars); **Star** (Stars in the universe).



West Quoddy Lighthouse in Lubec, Maine, U.S.A., is noted for its stripes. This pattern serves as a *day marker,* enabling mariners to distinguish the lighthouse from others during the day.



Drum Point Lighthouse sits on a multilegged platform in the shallows of Chesapeake Bay in Virginia, U.S.A. Its beacon beams alternate flashes of white and red light.

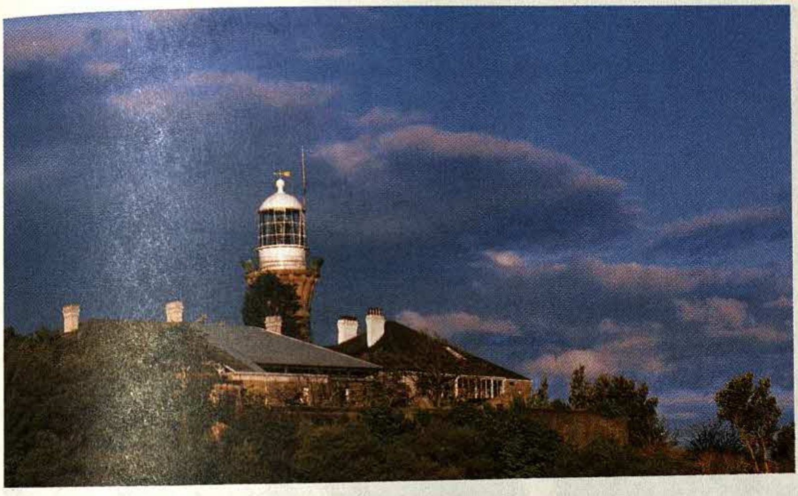
Lighthouse is a tower with an extremely strong light that serves as a navigational aid for mariners. Lighthouses help sailors determine their position, inform them that land is near, and warn them of dangerous rocks and reefs. Lighthouses are built at ports and harbours, on capes and peninsulas, and on isolated rocks. Some are built in the sea itself, with their foundations sunk into rock or coral beneath the water.

Lighthouses have been used as navigational aids for thousands of years. Since the 1940's, however, they have declined in importance because of the development and increased use of advanced electronic navigational aids (see **Navigation** [Electronic navigation]). For example, the number of lighthouses operated in the United States has declined from about 1,500 in the early 1900's to about 340 today. In fact, there are only about 1,400 lighthouses currently in use worldwide.

Identifying lighthouses. Every lighthouse emits a distinctive pattern of light known as its *characteristic.* There are five basic types of lighthouse signals: (1) fixed, (2) flashing, (3) occulting, (4) group flashing, and (5) group occulting. A fixed light is a steady beam. A flashing light has periods of darkness longer than periods of light. An occulting light's periods of light are longer than its periods of darkness. A group flashing light gives off two or more flashes at regular intervals, and a group occulting light consists of a fixed light with two or more periods of darkness at regular intervals. There are several variations of these basic identification patterns. For example, flashes of white light may alternate with flashes of red.

The characteristics and locations of lighthouses are recorded in publications called *light lists.* Mariners determine which lighthouse they are seeing and therefore their location by observing the characteristic of a lighthouse and consulting a light list.

In the daytime, lighthouses can be identified by their structure. Most lighthouses are simple towers made of stone, brick, wood, or steel. Some are metal skeletal



Barrenjoey Lighthouse is on the tip of Barrenjoey Peninsula, at the mouth of the Hawkesbury River north of Sydney in Australia. It dates from 1881.

towers, and others consist of houselike structures atop a multilegged platform. In areas where they are of similar construction, lighthouses are distinguished by their *day marker* pattern—a design of checks and stripes painted in vivid colours on lighthouse walls.

How lighthouses work. Lighthouses project their light through special lenses that increase the intensity of the light from their lamps. Many lighthouses are equipped with a *Fresnel,* or *classical, lens,* which is a huge compound lens that encircles the lamp. Each face of a Fresnel lens is surrounded by a ring of triangular prisms, which reflect and strengthen the light. Such a lens may project light more than 32 kilometres. Some Fresnel lenses measure as much as 2.4 metres in height and 1.8 metres in diameter.

A Fresnel lens produces alternating intervals of light and darkness by flashing automatically. A flashing effect can also be produced by arranging the prisms of part of the lens so they prevent light from escaping, and then revolving the lens around the lamp. A series of flashes of different colours is obtained by covering sides of the lens with coloured glass.

Some lighthouses produce their light through the use of *sealed-beam lamps,* which swing a beam across the horizon like a searchlight. The filament, reflector, and lens of such lamps are combined in a single unit. The number of times the light can be seen in a certain period depends on how fast the lamp is rotated.

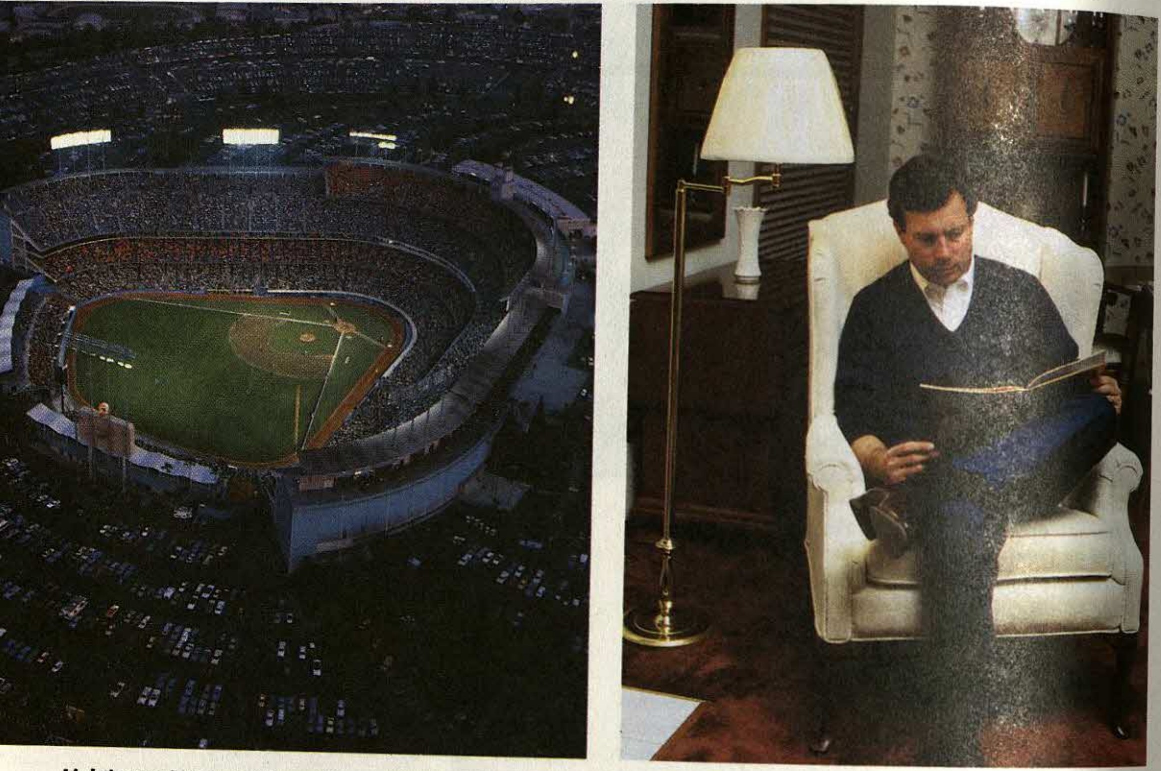
The distance a lighthouse's signal can be seen depends on a number of factors, including the beam's strength and the height of the light. Haze, smoke, and bad weather—such as fog, rain, and snow—also affect visibility. As a result, many lighthouses have foghorns, bells, or other sound-making devices that are used to signal vessels under such conditions. Many lighthouses also are equipped with *radio beacons* that send out radio signals, which can be picked up by shipboard radio direction finders.

History. The ancient Egyptians were probably the first people to use light to guide ships. They kindled fires on top of hills at night and later built lighthouses that also used fire as the light source. During the reign of Ptolemy II (283-246 B.C.), the Egyptians completed the Pharos of Alexandria, the tallest lighthouse ever constructed. The structure stood over 120 metres high. It guided ships for about 1,500 years.

The Romans built lighthouses at a number of ports. About A.D. 43, for example, they constructed light towers on both sides of the English Channel, at Dover in Britain, and at Boulogne-sur-Mer in Gaul (now France). The light beam for these towers was probably produced by a system of multiple flames and mirrors.

The first lighthouse built on a wave-swept rock was Eddystone Rock Light, southwest of Plymouth, England.

Eddystone Lighthouse stands on a rock in the English Channel. This structure is the fourth lighthouse to occupy the site. Its tower is 51 metres high.



Lighting enables us to take part in activities we enjoy at any time we wish. Lights in sports stadiums allow fans to enjoy games at night. At home, lighting lets us read or study at any hour.

This lighthouse had a base of huge blocks of stones. Completed in 1698, it was destroyed by a storm in 1703. Since then, three other lighthouses have occupied the site.

Australia's first lighthouse, the Macquarie Lighthouse at South Head in Sydney, was designed by the convict architect Francis Greenway. In 1817, on the completion of the lighthouse, Governor Lachlan Macquarie gave Greenway a pardon for the remainder of his 14-year sentence for forgery. The lighthouse began to crumble in the 1870's and was razed. The lighthouse that stands there today was rebuilt in 1883, following Greenway's plans.

Until the introduction of automation, lighthouses were operated by lighthouse keepers who lived with their families in or near the lighthouse. The lighthouse keeper's duties included lighting the wick, polishing the reflecting mirrors, cleaning soot off the tower windows, replacing the oil consumed by the light, rescuing shipwrecked sailors, and sometimes firing a warning cannon during periods of fog.

In 1822, Augustin Fresnel, a French physicist, invented the Fresnel lens. Initially, the Fresnel lens revolved around the lamp by means of a clocklike mechanism. But today, electric motors provide the power to revolve the lens and light the lamp.

See also **Beacon; Seven Wonders of the Ancient World; Stevenson, Robert.**

Lighting is a term that generally refers to artificial light—in most cases, electric light. We use artificial light both indoors and outdoors instead of—and in addition to—natural light from the sun. With lighting, we can use windowless areas of homes, hospitals, offices, schools, shops, and other buildings 24 hours a day. Lighting also enables us to use outdoor sports areas, such as football pitches and tennis courts, at night.

Lighting provides safety in a number of places. At home and at work, good lighting helps us see things clearly and avoid accidents. Street lights and car lights help us travel safely. Signal lights guide motorists, aeroplane pilots, railway engineers, and ship captains.

Companies and shops use lighted signs to identify themselves and to advertise their products. Lighting also adds beauty to homes and other buildings and to parks.

Good lighting helps the eyes work easily. Reading or working in poor light cannot damage the eyes. But it may cause fatigue or eyestrain and lead to dizziness, headaches, or sleepiness.

How we use lighting

We use artificial lighting in four chief ways: (1) in the home; (2) in offices, shops, and factories; (3) on streets and major roads; and (4) for outdoor events. Regardless of where lighting is used, people depend on it for general seeing and safety, for specific activities, and for decoration.

In the home, electric lamps and lighting fixtures provide light and safety for people walking from room to room or up and down stairs. Every room and passageway needs at least some general lighting so that things can be seen to avoid accidents. Each area should have a light that can be turned on before entering.

Many activities require extra lighting in addition to general lighting. Bathrooms, for example, often have special lighting that people use when putting on makeup or shaving. Bedrooms and living rooms may have additional lighting for such activities as reading, studying, and sewing.

Interior decorators use lighting to create various moods and to bring out the colours of walls and fabrics in a home. Incandescent lamps and warm white fluorescent lamps emphasize reds, yellows, and oranges (see **Electric light** [Incandescent lamps; Fluorescent lamps]). Cool white fluorescent lamps bring out blues and greens. Many people arrange spotlights or tinted lights to create interesting shadows. Others do so to draw attention to such objects as pictures or vases.

In offices, shops, and factories, proper lighting helps employees work efficiently and avoid costly accidents. Good lighting also provides a cheery atmosphere and reduces fatigue caused by eyestrain. In retail shops, proper lighting may help attract customers or bring out the best colours in merchandise.

Most offices and shops provide a large amount of general illumination, with additional lighting for such detailed jobs as repairing watches or making maps. Many factory jobs require more difficult eye work than do office jobs. Thus, factories need good lighting for safe, efficient work.

Improvement of lighting can also improve the quality of a company's products because employees may avoid errors that they otherwise might have made. One German manufacturer reported that his customers rejected 50 per cent fewer of his firm's products after he improved the lighting in his plant.

On streets and major roads, lighting helps people travel safely. Cities around the world have reduced night traffic accidents by improving their street lighting. Night accidents in some cities dropped as much as 50 per cent after street lighting was improved. And by installing lights on unlit roads, urban authorities can reduce traffic deaths and injuries on these roads by as much as 50 per cent. Street lighting also helps to provide safety by discouraging criminals.

Decorative lights on buildings may reduce the necessity for street lighting. In some cities, lighting designers plan light so that it accents the architecture as it illuminates the streets and pavements.

For outdoor events. Floodlights illuminate football pitches, golf courses, race tracks, swimming pools, tennis courts, and many other facilities for sports competition at night. Some sports, such as golf and swimming, require relatively little light. Others, including football, need much more light because they use larger fields and attract larger crowds. Additional lighting is required to televise outdoor events.

Outdoor lighting also allows such events as fairs and open-air theatre performances to be held at night. Clubs, resorts, and homes use decorative lighting for night parties held outdoors.

What is good lighting

Good lighting allows the eyes to function comfortably and efficiently. The eyes need different amounts and types of light for different activities. As a result, lighting that may be suitable for some activities may be inadequate for others.

Quantity of light needed for various activities depends on four factors: (1) the size of the things we are looking at, (2) the length of time we have to look at them, (3) the contrast between them and their background, and (4) our own seeing abilities. A watchmaker, who usually works with tiny parts, requires more light than a plumber, who connects large pipes. A person needs more light to read a road sign while speeding past in a car than while walking by. A tailor needs more light to sew black thread on black cloth than to sew white thread on black cloth. Older people generally need more light than young people to perform the same seeing tasks.

In the home, most people do not provide for the wide variety in the amount of light required for different activities. For example, a woman may use the same light for reading a newspaper and for hemming a black skirt with black thread. But her eyes need almost seven times as much light for sewing with black thread on a black garment as for reading.

Engineers use either the *lux* or *foot-candle* to measure the amount of light that falls on a surface. The lux is a metric unit and the foot-candle is a unit in the imperial system of measurement. An instrument called a *light meter* records how much light a surface receives at that point. See **Light meter; Light** (Measuring light).

Three factors determine how much light reaches any object: (1) the *intensity* (strength) of the light, (2) the distance of the object from the light source, and (3) the light distribution.

Intensity. Scientists measure the intensity of light coming from any source in units called *lumens.* In most countries, *lamps* (bulbs) are marked with their number of *watts.* Watts tell the amount of electricity used by a lamp, not how much light it produces. For example, two 50-watt lamps supply fewer lumens than one 100-watt lamp. A 100-watt lamp may provide only a fourth as many lumens as a 100-watt fluorescent tube. The United States is one country in which lamp cartons are marked with both lumens and watts.

Distance. According to a principle known as the *inverse square law,* the amount of light an object receives depends on its distance from the source. An object placed 2 metres from a lamp receives only a fourth as much light as when the object is placed 1 metre from the lamp.

Distribution. Dark colours absorb light, and so dark carpets, ceilings, curtains, furniture, or walls may limit the amount of light in rooms. But pale-coloured walls and furnishings reflect light back into a room.

A lamp shade distributes the light from a bare bulb and shields the bulb from direct view. The shade directs light downward toward the seeing task and upward to help light the room. Opaque shades send all the light up and down, but translucent shades transmit some light to the room. Coloured shades tend to colour the light. For this reason, shades with white or near white linings should be used.

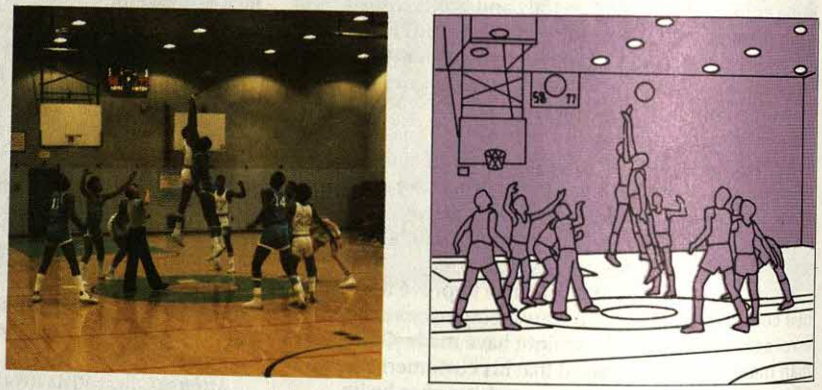
Efficient use of lighting can conserve energy. Different types of lighting can provide different amounts of light while using the same amount of energy. For exam-

Examples of good lighting

These photographs show the use of proper lighting for different indoor activities. The diagrams to the right of each photograph show the light sources used and the areas they illuminate.

In an office, fluorescent and incandescent lights recessed in the ceiling provide even desk light for efficient work. Fluorescent lighting provides bright light without heating up the room.

In a large area, such as a basketball court, factory, or warehouse, an even amount of light is needed over the entire floor. Incandescent lighting fixtures near the ceiling provide lighting for the floor.



ple, incandescent lamps provide about 20 lumens per watt, while fluorescent lamps provide 70 lumens per watt.

Engineers and scientists are continually looking for ways to improve the efficiency of lamps. They have developed vapour lamps with improved efficiencies over incandescent lamps. For example, *mercury vapour lamps* provide 50 lumens per watt, *metal halide lamps* provide 90 lumens per watt, and *high pressure sodium lamps* provide 110 lumens per watt. Vapour lamps also last longer than incandescent lamps. Scientists are also producing improved, more compact fluorescent lamps.

Lighting problems may occur even if enough light has been provided for an activity. For example, a bright light that shines, or is reflected, directly into the eyes causes glare, which can cause discomfort. Severe glare, such as that caused by the headlights of some cars, may be temporarily blinding. Lamps and fixtures that *diffuse* (scatter) the light tend to produce more comfortable illumination. Indirect lighting, in which all the light from the source is reflected from ceilings and walls, produces completely glare-free and comfortable lighting.

An unshaded clear glass bulb gives off harsh, undiffused, glaring light. Lamps with frosted, or white, bulbs and tubes give some diffusion, but still should be shielded or positioned so they do not shine directly in a person's field of vision. A globe or diffusion bowl can be used to conceal the bulb and help diffuse the light.

Even if a light source does not cause glare directly, other surfaces, such as glossy finishes on walls, furniture, and paper, may produce reflected glare. Sharp colour contrasts on work surfaces, such as white paper on a dark blotter, may also cause discomfort. At first, the colour contrast helps the eyes see the objects. However, in time the colour contrast strains the eyes, which must refocus each time they move from a light surface to a dark surface.

Sharp contrasts in the brightness of lighting can also cause eyestrain. For this reason, a person should not watch television in a completely dark room or study by the light of a single intense lamp. To avoid harsh contrasts, the eyes need general lighting in addition to the light from the television screen or the lamp.

Lighting devices

Many people use combinations of fluorescent and incandescent fixtures and portable lamps for attractive home lighting. Incandescent and fluorescent fixtures may be mounted on a wall or ceiling, recessed above the ceiling, or suspended from the ceiling. Suspended fixtures provide good general lighting for high-ceilinged halls or stairways. Recessed fixtures above sinks or other work areas furnish good lighting for various activities. Many offices and family rooms have *luminous ceilings,* in which fluorescent tubes are hung above the translucent ceiling. Such fixtures provide

In an office lobby, light from fluorescent fixtures in the ceiling supplements the natural light from the windows. The artificial light reduces the contrast between the areas near the windows and the darker corners of the room.

In a home, a combination of windows and incandescent lamps and fixtures provides good light for reading. Lighting in homes should help to create a pleasant environment.

softly diffused general light. A large number of institutions, including hospitals, libraries, and schools, also have luminous ceilings.

Portable lamps give homes soft general lighting, and extra lighting for such activities as sewing or studying.

In homes and small offices, lighting designers may conceal fluorescent tubes behind fascias mounted at the edges of the walls or ceiling. Such *structural lighting* provides soft indirect light and draws attention to the walls and curtains. Structural lighting on two opposite walls of a square room makes the lighted walls seem farther apart than the unlighted ones. When mounted on a low ceiling, structural lights give the illusion of greater height in the room.

Most factories, large offices, schools, and shops use fluorescent or vapour fixtures for general lighting. Fluorescent lights produce as much as three times, and vapour lamps produce up to six times, the light per watt of electricity as do incandescent lamps. Thus, for the same amount of light, fluorescent or vapour lamps cost less to burn. They also produce less heat. However, lighting engineers sometimes prefer incandescent lamps because of their compact size, flexibility of use, or their more familiar warm colour. Some shops use a combination of fluorescent or vapour fixtures for general lighting and incandescent lamps for decorative and accent lighting.

Related articles in ***World Book*** include:

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Candela
Candle
Electric light
Fluorescent lamp
Invention (Inventions that give people light)
Lamp
Lantern
Light
Neon
Theatre (Lighting)
Vapour lamp

Lightning is a giant electrical spark in the sky. Most of the lightning people see takes place between a cloud and the ground. But lightning also occurs within a cloud, between a cloud and the air, and between two clouds. When lightning occurs in the atmosphere, its electrical energy scatters in the air. This energy may damage aeroplanes travelling through it, but it does not cause harm on the ground. But lightning that strikes the earth may kill people or cause fire.

Lightning that strikes the earth consists of one or more electrical discharges called *strokes.* The bright light that we see in a flash of lightning is called a *return stroke.* Return strokes travel at about the speed of light, which is 299,792 kilometres per second. They discharge about 100 million volts of electricity and heat the air in their paths to over 33,000° C. Air heated by return strokes expands quickly, producing a wave of pressure called thunder. See **Thunder.**

Flashes of lightning vary in length. A flash between a cloud and the ground may be up 14 kilometres long. A flash that travels through clouds side by side may be over 140 kilometres long.

Through the centuries, lightning has been one of the greatest mysteries of nature—and it is still not understood completely. The ancient Greeks and Romans thought lightning was a weapon of the gods. In some African societies, people and places hit by lightning were considered to be cursed. As late as the 1700's, some people in Europe and America believed lightning could be kept away by ringing church bells.

Serious study of lightning began in the 1700's. The American scientist and diplomat Benjamin Franklin was one of the first people to experiment with electricity. In 1752, he showed that lightning is electricity. He tied a metal key to the end of a kite string and flew the kite in a thunderstorm. Cloud electricity raised the voltage of the kite string. The high voltage caused a spark to jump from the key to grounded objects, proving that the cloud was electrified. Franklin's experiment was dangerous, and some people who have flown kites in storms have been electrocuted by lightning.

How lightning occurs

Everything around us is made up of atoms. Although atoms are normally electrically neutral, they may become positive or negative if they lose or gain electrons. Positive and negative charges are attracted to one another. When they move through air toward one another, they form an electric current that causes a spark. Lightning is the spark that results from the rapid movement of electrically charged particles within a *cumulonimbus cloud* (thundercloud) or between such a cloud and the ground, the air, or another cloud.

Electrically charged clouds. Scientists are uncertain exactly how cumulonimbus clouds become electrically charged. Most believe, however, that the charge results from the collision of a cloud's light, rising water droplets and tiny pieces of ice against hail and other heavier, falling particles (see **Cloud**). When these bits of cloud collide, the heavier particles gain a negative charge and the lighter particles acquire a positive charge. The negatively charged particles fall to the bottom of the cloud, and most of the positively charged particles rise to the top. Lightning is produced when separated positive and negative charges flow toward one another—or toward opposite charges on the earth—thereby forming a spark.

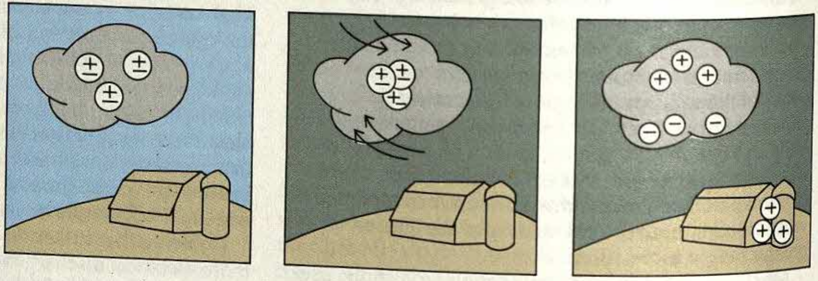
The most common type of lightning, called *intracloud lightning,* is created when charges within a cloud form an electrical spark. Charges that flow between a cloud and the air cause *cloud-to-air lightning,* and an electrical current between two clouds produces *cloud-to-cloud lightning.* Lightning that results from the flow of charges between a cloud and the earth may be either *cloud-to-ground lightning,* or *ground-to-cloud lightning,* depending on the direction in which the charges first began to flow. Most of the lightning that people see is cloud-to-ground lightning.

Strokes. The first stroke of a flash of cloud-to-ground lightning is started by a *stepped leader,* which usually carries negative charges from a cloud toward the ground. No one knows for certain how a stepped leader begins. However, many scientists believe it is triggered by a spark between areas of positive and negative charges near the base of a thundercloud.

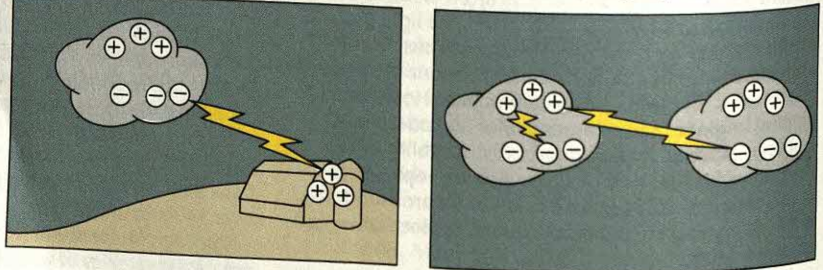
A stepped leader moves downward in a series of steps, each of which is about 45 metres long and lasts about 1 millionth of a second. It pauses between steps for about 50 millionths of a second. As the stepped leader nears the ground, positively charged upward-moving leaders travel up from such objects as trees and buildings to meet the negative charges. Usually, the upward-moving leader from the tallest object in the area is the first to meet the stepped leader and complete a route between the cloud and the earth. Negative charges then rush down to the ground along the path provided by the upward-moving leader. The negative charge nearest the ground moves downward first, followed by negative charges from higher and higher altitudes. This process of the upward motion of current is the return stroke. A return stroke produces the light people notice in a flash of lightning, but the current trav-

How lightning occurs

Lightning is caused by the movement of positive and negative electrical charges toward one another. During a storm, a thundercloud's particles collide and become electrically charged. The positively charged particles rise to the top of the cloud and the negatively charged particles fall to the cloud's base. When negative charges from the cloud's base move downward and meet with rising positive charges from the earth, *cloud-to-ground lightning* occurs. Lightning between charges within a cloud is called *intracloud lightning.* That which occurs between charges of different clouds is known as *cloud-to-cloud lightning.*



Before a storm **Particles collide** **Charged particles separate**



Cloud-to-ground lightning **Intracloud and cloud-to-cloud lightning**

els so quickly that its upward motion cannot be perceived.

A flash of lightning may end after one return stroke. But in most cases, *dart leaders,* which are similar to stepped leaders, carry more negative charges from the cloud down the main path of the previous stroke. Each dart leader is followed by a return stroke. The leader-stroke process commonly occurs 3 or 4 times in one flash, but may occur more than 20 times. People can sometimes see the individual strokes of a flash. At such times, the lightning appears to flicker.

Forms of lightning

Lightning occurs in a variety of forms. A single flash of lightning often varies in appearance, depending on the position of an observer in relation to it.

The major forms of lightning include *forked lightning, streak lightning, ribbon lightning,* and *bead,* or *chain, lightning.* Forked lightning refers to a flash in which multiple branches of a stroke are visible. Streak lightning is a flash that seems to illuminate a single jagged line. Ribbon lightning appears as parallel streaks of light. It is formed when wind separates the strokes of a flash. Bead, or chain, lightning is a flash that breaks up into a dotted line as it fades.

Some electrical flashes in the sky—such as *heat lightning* and *sheet lightning*—are not really separate forms of lightning, though they appear different in some ways. Heat lightning, often seen on summer nights, seems to occur without thunder. Actually, it is lightning that occurs too far away from an observer for its accompanying thunder to be heard. The people underneath what looks from a distance like heat lightning are experiencing a normal thunderstorm. Sheet lightning appears as an illumination of a portion of the sky. But it is lightning whose distinct flashes either are too far away to be seen or are hidden from view by clouds.

A form of lightning called *ball lightning* differs greatly from ordinary lightning. Ball lightning appears as a glowing, fiery ball that floats for several seconds before disappearing. It has reportedly been seen during thunderstorms, usually after ordinary lightning has occurred. It is described as a red, yellow, or orange ball that may be as large as a grapefruit. It has been reported floating along the ground and inside houses, barns, and aeroplanes. No one knows how or why ball lightning occurs, or what it consists of.

A glowing light called *St. Elmo's fire* may resemble ball lightning in some ways. St. Elmo's fire is caused by electrical discharges from a sharp object during a thunderstorm. It sometimes appears around aeroplanes, the masts of sailing ships, towers, and treetops. See **Saint Elmo's fire.**

Protection from lightning

Lightning strikes the earth about 100 times each second. People can avoid being struck by lightning by following certain safety measures during thunderstorms.

Take shelter in a house or large building. It is safe to stay in an enclosed car or truck, but not in a convertible. Do not touch any metal inside the vehicle.

Use the telephone only in emergencies.

If you are caught in an open area sit or crouch down. Do not stand under or near an individual tall tree or any similarly isolated object in an open area.

Lightning is a giant electrical spark in the sky. It often strikes tall buildings, *above,* and may do little damage. But lightning can kill people, destroy property, or cause fire.

Do not rise above the landscape by standing on a hilltop, on a beach, or in an open field.

Stay out of and away from water.

Get away from open metal vehicles, such as bicycles, golf carts, farm equipment, and motorcycles.

If you are stranded in a forest, take cover beneath low shrubs or a group of trees of similar height.

A person who has been struck by lightning should be treated with *cardiopulmonary resuscitation,* an artificial method of breathing and circulating blood. See **First aid** (Heart attack).

Metal poles called *lightning conductors* help protect buildings from lightning. They are attached to building tops and must be well earthed. They attract lightning and direct its electricity through a wire or cable safely to the ground. See **Lightning conductor.**

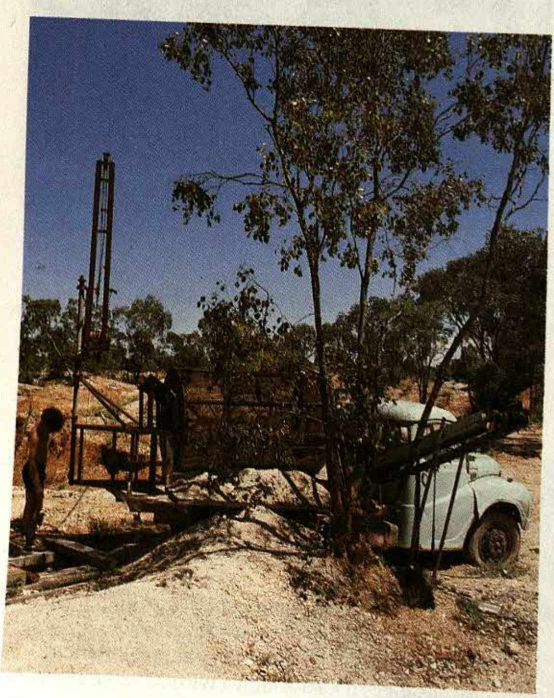
Lightning bug. See **Firefly.**

Lightning conductor is a device that protects homes and other buildings from damage by lightning. A common type has a metal rod installed on top of a building. A wire or cable leads from this rod to an *earth conductor* buried 3 metres or more in the earth. The earth conductor should be buried at least 60 centimetres from the building in moist earth. It should be as straight as possible. If a building has several metal supports, each of the supports should be connected to a lightning conductor and there should be several earth connections.

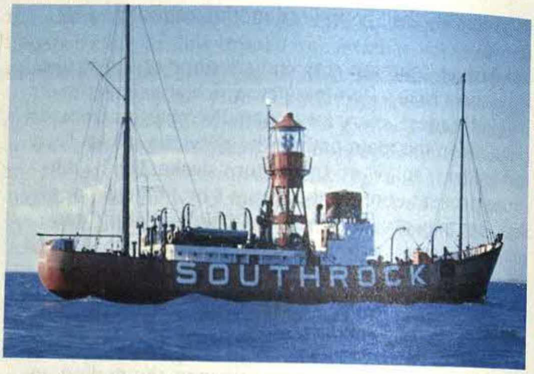
Lightning conductors are most often used in farming regions to protect homes and farm buildings. They are not often seen in cities, because there is so much metal used and the buildings stand close together. Other kinds of lightning protectors are used on power stations, telephone wires, and electric structures.

Lightning Ridge is an opal-mining centre situated in central northern New South Wales, Australia, about 770 kilometres from Sydney, 75 kilometres north of Walgett, and 50 kilometres south of the Queensland border. It is the most productive opal field in New South Wales and the world's major source of high-quality *black opal,* a variety of precious opal that has a very dark colour and commands a high price because of its pattern and rarity. The opal fields at the centre consist of about 60 fields located within 10 kilometres of the township. Most opal mining is done mechanically today, but searching for opal is a great attraction for tourists visiting the Lightning Ridge area.

Lightvessel is a type of ship or buoy that acts as a lighthouse. About 10 lightvessels guard the shores of the British Isles, for example.



Mining is an important economic activity in Lightning Ridge. The township is the world's major source of black opal.



Southrock lightvessel is provided by the Commission of Irish Lights to help ships navigate in the North Irish Sea.

Most lightvessels are automatic, and their performance is monitored by a radio link to a land-based control station. Lightvessels operated by people on board have a crew of five, serving one month at sea then a month on shore. The crews are transported to and from the lightvessel by helicopter, and boats carry supplies and equipment to them.

Lightweight. See **Boxing** (Weight classes).

Lignin is a complex substance formed by certain plant cells. It is one of the chief substances in wood. Lignin, found in the cell walls of woody tissue, is closely associated with cellulose. It is made up of the same elements as cellulose, but its exact chemical composition is still unknown. Lignin, like cellulose, permits water and gases to pass through it. It turns yellow when treated with sulphuric acid and iodine, while cellulose turns blue. In the manufacture of paper, lignin is removed from wood by treating the wood fibres with sodium sulphite or sodium hydroxide.

Once regarded as a waste product in paper manufacturing, some lignin is now used as fuel in paper-pulp mills. It is also used in making plastics, fertilizer, artificial vanilla, cosmetics, building board, rubber, fire extinguishers, and other items.

Lignite, also called brown coal, is a coal of low quality. Lignite contains 20 to 60 per cent water when mined, much more than higher quality coal. It is a soft coal consisting of a compacted fossilized form of wood. It is an intermediate material between peat and true coal. It is used for firing boilers. Large deposits of lignite lie in Germany as well as in parts of the north-western United States and western Canada.

See also **Coal** (Uses of coal; How coal was formed).

Lignocaine is a drug used to block pain sensation in a specific part of the body. Such drugs are called *local anaesthetics.* Lignocaine is used in surgical and dental procedures for *regional nerve blocks.* That means it is injected around nerves that control sensation in particular areas. Lignocaine also is used in prescription and nonprescription ointments and sprays, which produce anaesthesia for minor skin injuries. Another use for lignocaine is the treatment of certain types of abnormal heartbeats.

Pure lignocaine is a white, odourless powder with a slightly bitter taste. Its effects are similar to those of *pro-*

caine (a local anaesthetic with the brand name *Novocain*), but lignocaine lasts longer and is more potent. Lignocaine was first synthesized in 1946 and has since become the standard to which other local anaesthetics are compared. Its brand name is *Xylocaine.*

See also **Anaesthesia** (Local anaesthesia).

Lignum vitae is an extremely hard wood obtained from certain Latin-American trees. The trees grow in the West Indies, Mexico, Central America, and northern South America. They are sometimes called *guayacans.* The Latin words *lignum vitae* mean *wood of life.* The wood was so named because its resin was used to treat rheumatism, catarrh, and skin diseases.

The heartwood of lignum vitae is the most useful part of the tree. This wood is so dense that it sinks in water. The wood is olive-brown in colour, and contains an oily resin which acts as a lubricant when the wood is used for bearings. The grain of lignum vitae interlocks lightly and closely and makes it practically impossible for the wood to be split.

Lignum vitae is used for the stern propeller-shaft bearings in steamships, for the sheaves and blocks of pulleys, and for mallets, and furniture casters. A resin known as *guaiac* is extracted from the wood and used in the pharmaceutical industry.

Scientific classification. Lignum vitaes belong to the caltrop family, Zygophyllaceae. The two species are *Guaiacum officinale* and *G. sanctum.*

Liguori, Saint Alphonsus. See **Alphonsus Liguori, Saint.**

Ligurian Sea is the broad portion of water between the Gulf of Genoa and the Mediterranean Sea. The Italian region of Liguria lies north along this sea beyond the gulf. The island of Corsica lies to the south. For location, see **Italy** (physical map).

Lij Iyasu. See **Ethiopia** (History).

Lilac is a beautiful shrub that is loved throughout the world for its fragrant flowers. The *common lilac* from southeastern Europe grows to a height of 6 metres and has wide, spreading branches thick with flowers. Its green leaves are about 13 centimetres long. The white or purple flowers grow in clusters that may be 25 centimetres long.

The beautiful lilac is popular throughout the world. Nurseries have developed many varieties of this plant.

Lilac bushes can be grown in almost any garden, and the plant needs little attention. Lilacs may be grown by cuttings from green lilac wood, ripe wood, or roots. Some kinds of lilacs are grown by grafting or budding. Lilacs grow best in northern climates. Nurseries in northern regions have developed many different kinds which have larger and more colourful blossoms than the common lilac. Their colours vary from white to dark purple and deep red.

Lilacs can be made to bloom in the winter by keeping them under glass. The plants are put in pots in the spring and taken outdoors later in the summer. The plants bloom in three to five weeks if they are kept in a temperature from 16° to 27° C.

A light purple colour is called "lilac" after the lovely light purple flowers of some lilacs. Many poets have written about the beauty of lilacs. Perhaps the most beautiful of such poems is the ode the poet Walt Whitman wrote on the death of Abraham Lincoln, the American President, called "When Lilacs Last in the Dooryard Bloom'd."

Scientific classification. Lilacs belong to the olive family, Oleaceae. The common lilac is classified as *Syringa vulgaris.*

See also **Flower** (picture: Garden perennials [Flowering shrubs]); **New Hampshire** (picture).

Lilienthal, Otto. See **Glider** (History).

Liliuokalani, Lydia Kamekeha (1838-1917), reigned as queen of Hawaii from 1891 to 1893. She became queen after the death of her brother, King David Kalakaua.

American settlers who controlled most of Hawaii's wealth revolted in 1893 when Liliuokalani tried to restore some of the monarchy's power. A republic was established in 1894, and the new government hoped the United States would annex Hawaii. But U.S. President Grover Cleveland tried in vain to restore Liliuokalani to her throne. Hawaii was eventually annexed by the United States in 1898.

Liliuokalani made two trips to the United States after she lost her throne. She is perhaps best known today for her song, "Aloha Oe," which became the traditional farewell song of Hawaii.

Lille (pop. 168,424; met. area pop. 936,295) is an industrial city in northern France (see **France** [political map]). The city is a centre of textile production. Other industries include the production of cars, electronic equipment, and petrochemicals. Lille also has great printing houses, sugar and oil refineries, and dye works. Its art museum has paintings by Rubens, Goya, Van Dyck, and others.

Lille was founded about 1030 by the Flemish. The government of Flanders gave it to France in 1312. Eugene, Prince of Savoy, captured the city in 1708, but the Peace of Utrecht in 1713 restored it to France. German troops captured and occupied Lille in World War I (1914-1918) and in World War II (1939-1945).

Lillee, Dennis (1949-   ), a West Australian cricketer, became one of the best fast bowlers in the world. Lillee was the outstanding bowler of the match in the Centenary Test between Australia and England in 1977. During his Test career, which started in 1970 and ended in the 1983-1984 season, he played in 70 Test matches.

He took a world record 355 wickets, at an average of 23.92 runs per wicket. He took 5 or more wickets in an innings on 23 occasions.

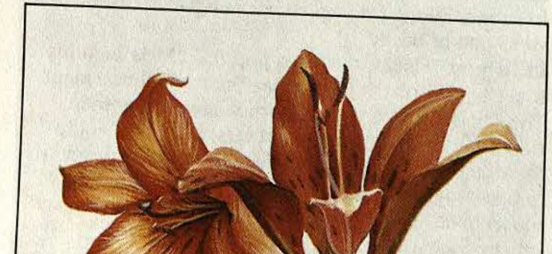
Lillie, Beatrice (1894-1989), an English actress, won fame as one of the brightest and most natural comediennes of her time. She appeared in more than 40 shows after her first professional appearance in 1914. She became especially known for her monologue called "Double Damask Dinner Napkins." Lillie was born in Toronto, Ontario, Canada. As a girl, she sang with a Presbyterian church choir. But she was asked to resign because her comic antics interfered with the rehearsals of the church choir. She received the name Lady Peel when she married Sir Robert Peel in 1920.

Beatrice Lillie

Lilongwe (pop. 186,000) is the capital of Malawi, in southeast Africa. The city lies on the Lilongwe River in the heart of Malawi's agricultural area and is a marketing centre for tobacco and other crops. For location, see **Malawi** (map).

Lilongwe was settled in 1902. It became a city in 1966, when it was designated to replace Zomba as the Malawi capital. At that time, fewer than 20,000 persons lived in Lilongwe. The city's population climbed during the several years of an extensive government construction programme that included factories, government buildings, and residential areas. Lilongwe officially became the capital in 1975.

Lily is one of the largest and most important plant families. The name is used for many garden and hothouse flowers, such as the tiger lily, the Madonna lily, the white Easter lily, and the Chinese and Japanese lilies. The lily family also includes a number of plants that are important to agriculture, such as asparagus and aloe. A few flowers which do not have *lily* as part of their name, such as the hyacinth and the trillium, are also in the lily family. But the calla lily and water lily are not members of the lily family.



Wood lilies have bright, orange-red petals with purple spots. There are about 80 species of true lilies.

There are more than 200 genera in the lily family, with about 4,000 species. True lilies number about 80 species, found across the temperate zone of the Northern Hemisphere. There are also many *hybrids* (cross breeds). Lily flowers usually have six petals and prominent stamens. They vary in size from the Turk's-cap lily, about 2.5 centimetres across, to types with trumpet, or bowl-shaped blooms, up to 25 centimetres across. Many lilies have a strong sweet fragrance. The fruit of a lily is a capsule containing many seeds.

Lily flowers grow from scaly bulbs. Most varieties of lilies have clusters of bright-coloured flowers on upright stems. The blossoms are trumpet-shaped and have six petals.

Lilies grow best in deep, sandy loam that is well drained. They should be sheltered from strong winds and hot sun. Bulbs of most lilies are planted 15 centimetres or more under the soil in late fall or early spring. They are placed deep because many produce roots from the stem above the bulbs. As soon as the plants bloom, the seed pods should be removed. The *Madonna lily* is planted in the autumn and is set only 5 centimetres deep because it starts a growth of foliage in late summer. This foliage lives through the winter. Madonna lilies are grown commercially in the South of France for their fragrant oil that is used in perfumes. In some countries, especially Japan, the bulbs of some species are used as food.

The most serious disease that attacks lilies is called *mosaic virus.* It is carried from plant to plant by aphids and attacks every part of the plant except the seeds. When one of the plants becomes infected, it should be removed immediately and destroyed. Another disease, called *Botrytis blight,* also attacks lilies. It can be controlled by spraying the flowers once a week with appropriate *fungicides* (substances that kill fungi).

Scientific classification. True lilies belong to the lily family, Liliaceae. They are genus *Lilium.* The European Turk's-cap lily is *L. martagon,* and the Madonna lily is *L. candidum.*

Related articles in ***World Book*** include:

Aloe
Asparagus
Asphodel
Aspidistra
Bulb
Colchicum
Crocus
Day lily
Dogtooth violet
Easter lily
Flower (pictures)
Fritillary
Greenbrier
Hyacinth
Lily of the valley
Mariposa lily
Mosaic disease
Sego lily
Soap plant
Solomon's-seal
Squill
Star-of-Bethlehem
Tiger lily
Trillium
Tulip

Lily, Water. See **Water lily.**

Lily of the valley is a fragrant garden flower. Each blossom is shaped like a tiny bell. It grows in North America, Europe, and northern Asia.

The beautiful bell-shaped flowers are pure white. They hang down in a long cluster along a slender stem. The flower stalk rises from a *rhizome* (underground stem). Each stalk usually has two or three wide, oblong leaves. The fruit is a red berry about 6 millimetres in diameter. The plant requires rich, well-drained soil containing leaf mould and grows well in shade.

The lily of the valley has white, bell-shaped blossoms.

Lily of the valley is a perennial plant, flowering naturally in late spring. In greenhouses, it blooms during all seasons. Professional growers keep the plant's rhizome, called a *pip,* frozen at temperatures from −4° to −2° C until it is planted for flowering. The plant will grow outdoors for many years without needing to be moved. If they become overcrowded and new plants are required, the rhizomes can be lifted and divided from the autumn to the spring. The individual crowns should be planted 7 to 10 centimetres apart. In greenhouses, the plants should be kept at a temperature of about 18° C in order for them to bloom.

Lily of the valley is famous for its fragrance. A French toilet water called *eau d'or* is made from the flowers.

Scientific classification. Lily of the valley is a member of the lily family, Liliaceae. It is *Convallaria majalis.*

See also **Flower** (picture: Garden perennials).

Lim Bo Seng (1909-1944), a Chinese major general, became a hero during World War II (1939-1945). The Lim Bo Seng Memorial in Singapore was erected in his honour after the war.

Lim Bo Seng was born in Fujian, southern China. He arrived in Singapore at the age of 16. In the 1930's, he helped to prepare Singapore's defences against the Japanese. He formed a Chinese Liaison Committee, which organized workers to help with civil defence. On Jan. 31, 1942, Lim Bo Seng's quarry workers helped to blow up the Johor-Singapore Causeway to cut the Japanese route into Singapore. After Singapore fell in February 1942, he went to Chungking, China, and joined the underground resistance. After going to India to recruit men, he returned in 1943 to Perak in Malaya, where he joined the resistance fighters. The Japanese military police discovered him on March 27, 1944. He was tortured and put to death.

Lim Boon Keng (1869-1957), a Chinese doctor, promoted social and educational reforms in Singapore and China. He was the first to launch a campaign against opium smoking. At a time when it was considered unnecessary for girls to go to school, he actively promoted education for females. In 1899, he helped to found the Singapore Chinese Girls School.

Lim Boon Keng was born in Singapore. In 1887, he became one of the first Chinese studying in Raffles Institution to win a Queen's scholarship to study medicine at Edinburgh University. As a Chinese member of the Singapore Legislative Council from 1895 to 1902, he petitioned the British government for various improvements to the lives of the Chinese. Later, he went to China where he became inspector of the general hospitals in Beijing. In 1912, he was appointed confidential secretary and personal physician to Sun Yat Sen, the first president of the Chinese Republic. From 1921 to 1936, Lim Boon Keng was the first president of Amoy University, which was founded by Tan Kah Kee, a Singapore businessman.

Lima (pop. 5,493,900; met. area pop. 6,053,900) is the capital and largest city of Peru. It is the nation's major commercial, cultural, and industrial centre. Lima lies in western Peru, about 16 kilometres from the Pacific Ocean. For location, see **Peru** (political map). The Lima metropolitan area extends west to the Pacific. The Andes Mountains rise east of the area.

The city. The Plaza San Martín lies in the centre of Lima. The Colmena, Lima's main street runs east and west through the plaza. Hotels, office buildings, theatres, and private clubs surround the plaza. Farther south lies the Plaza de Armas, the original centre of Lima. Several historic buildings face this square, including the Cathedral of Lima, the city hall, and the Government Palace. Tall, modern buildings line the streets of the business district near the Plaza San Martín. Lima also has many mansions that were built when Peru was a colony of Spain—from the 1530's to the early 1800's. Many of these mansions are now government office buildings, museums, or restaurants.

Wealthy families live in some of the colonial mansions, and other residents of Lima occupy flats or luxurious suburban dwellings. However, many of the city's people live in public housing or inner-city slums. About a third of the population lives in squatter communities called *young towns,* which surround the city. Many of the houses in these communities are little more than huts made of materials such as bamboo, cardboard, straw, and tin.

Most of Lima's people are of Indian, Spanish, or mixed Indian and Spanish ancestry. They speak Spanish or Quechua, the language of the Inca Indians.

Attractions of Lima include the Museum of Peruvian Culture and the National Museum of Art. The ruins of Pachacamac, an ancient Indian city, are nearby. The National Library of Peru and the University of San Marcos, the oldest university in South America, are in Lima (see **San Marcos, University of**). The city has a symphony orchestra and a national theatre group. The cinema and soccer and other sports are favourite recreations among Lima's people.

Economy of Lima is based on the activities of the national government. The government is the largest employer of the city's people. Lima is also Peru's leading manufacturing centre. Major products include beer, clothing, cotton and woollen fabrics, and fish meal. Museums and other cultural features in and near Lima help

The Plaza de Armas in Lima, Peru, marks the historic centre of the city. Such major buildings as the cathedral shown above, the city hall, and the Government Palace face the square. The cathedral stands on the site of an earlier church built when Lima was founded in 1535.

attract tourists. The coastal city of Callao about 13 kilometres from Lima, has a port and an airport that serve the capital.

History. Francisco Pizarro, a Spanish adventurer, conquered most of Peru in 1532 and 1533 and founded Lima in 1535. During the 1600's and 1700's, Lima served as the centre of Spanish government in South America.

Most of Lima's industrial growth has occurred during the 1900's. Since the mid-1900's, many people have moved to the city from rural areas and small communities to search for jobs. As a result, a housing shortage has developed.The city also faces pollution problems because of its expanding industries and growing number of cars.

See also **Peru** (pictures).

Lima bean is the most nutritious member of the pea family. It is high in protein value, and rich in iron, calcium, and vitamins. This wide, flat bean first grew in tropical America. It now grows in many warm lands, especially the United States.

Like other beans, limas are seeds that grow in pods. The large limas often grow 25 millimetres wide and 5 millimetres thick. Some varieties have large seeds and others have small seeds. Lima beans may be green or white.

Some limas grow on vines that can be trained on poles or trellises. The pole beans are usually planted in hills, 60 to 120 centimetres apart. Other kinds of limas grow on bushes. Lima beans grow best in rich soil that does not have too much nitrogen. They need moist air and a long growing season.

Scientific classification. The Lima bean belongs to the pea family, Leguminosae (Fabaceae). It is *Phaseolus limensis.*

See also **Bean.**

Limavady (pop. 29,144) is a local government district in Northern Ireland. The district, centred on the market town of Limavady, on the River Roe, lies between Londonderry and Coleraine, on the shores of Lough Foyle and the Atlantic Ocean. Farmers in Limavady district grow cereals, potatoes, and hay. They graze sheep on the hills and raise beef and dairy cattle. Limavady's industries include printing and the making of ladies' underwear and synthetic fibre. Fine mountain scenery in the north and southeast of the district and a fine Atlantic beach and tourist complex provide attractions for visitors and holidaymakers. The present town of Limavady dates from 1610.

Limbo, in Roman Catholic theology, is the home of souls who belong neither in heaven nor in hell. *Limbo* is a Latin word that means *on the border.* Souls in limbo enjoy perfect natural happiness but lack the supernatural joy of seeing God.

Roman Catholic theologians have developed two concepts of limbo. *Limbus patrum* (fathers' limbo) is the temporary place or state of the souls of holy people who died before Christian times. Many Christians believe that after Jesus Christ rose from the dead, He took these souls to heaven. *Limbus infantium* (infants' limbo) is the eternal place or state of infants who have died unbaptized. The idea of *limbus infantium* rests on the belief that baptism is needed to enter heaven but that unbaptized infants have not sinned and thus do not de-serve hell. Many Roman Catholic theologians have taught the existence of *limbus infantium,* but it is not part of official church doctrine.

Limbourg, Pol de (? -1416), and his brothers Herman and Jean were noted manuscript painters called *illuminators.* Illuminated manuscripts are richly illustrated with miniature paintings and decorated borders. The Limbourgs worked in France for the Duc de Berry, a wealthy art patron. Their most famous manuscript for the duke was a prayer book called *Les Très Riches Heures* (*The Very Rich Hours*). One section of the book is a calendar showing the activities of each month. In the vividly coloured illuminations, beautiful lords and ladies amuse themselves while peasants work in front of exquisitely painted castles. Scenes from the book appear in the articles **Europe; Middle Ages;** and **World, History of the.** The Limbourgs were born in Nijmegen, the Netherlands.

Lime is an important industrial chemical. The chemical name for lime is *calcium oxide,* and its chemical formula is CaO. The word *lime* is also used to refer to *calcium hydroxide.* Calcium hydroxide, which has a chemical formula of $Ca(OH)_2$, is formed by a reaction of calcium oxide with water. Calcium oxide is also known as *quicklime,* and calcium hydroxide is also called *slaked lime* and *hydrated lime.* Both substances are bases.

Slaked lime has a wide variety of uses. It serves as a *flux* in the production of steel (see **Flux**). It also is used in the refining of aluminium, copper, and zinc. Lime "softens" water by removing certain minerals from it, and it plays a valuable role in the treatment of sewage as well. Many farmers spread lime on their fields to neutralize acid in soil, and homeowners often use lime on their lawns to prevent the growth of moss. Lime also helps stabilize soil in the foundations of roads and airport runways. In the production of leather, tanneries use lime to remove hair from animal hides. The *mortar* that is layered between bricks or stones in the walls of buildings is composed of a mixture of lime, sand, and water. Lime is also a key ingredient in plaster and in a kind of cement called *portland cement.*

Lime trees have dense foliage and small, purple-tinged flowers. Growers plant the trees in groves. The blossoms appear mainly in spring, and the fruit ripens in three to four months.

Limes are green citrus fruits that grow in clusters.

Most quicklime is made from small chunks of limestone. Limestone consists chiefly of calcium carbonate, which has the chemical formula $CaCO_3$. To produce quicklime, manufacturers place crushed limestone in a special oven, called a *kiln,* and heat it to a temperature of about 1204° C. This process releases carbon dioxide from the limestone, leaving a lump of powdery, greyish-white quicklime.

The production of slaked lime involves a further process called *slaking.* Water is added to a lump of cooled quicklime, resulting in a chemical reaction that produces heat and steam. As the steam evaporates, the lump of quicklime disintegrates into a fine, dry, white powder. This powder is slaked lime. If water is added in excess of the amount needed for slaked lime, a *slurry* (soupy mixture) of partially dissolved lime is created. This slurry is commonly known as *milk of lime.* When slaked lime is dissolved completely in water, the resulting product is a clear liquid called *limewater.* Limewater is used to detect the presence of carbon dioxide in a substance. If carbon dioxide is present, it turns the limewater milky-white.

Related articles in ***World Book*** include:

Calcium
Calcium carbonate
Cement and concrete (How cement is made)
Glass (Soda-lime glass)
Leather (Preparing the hides)
Limestone

Lime is a rounded fruit that is pointed at both ends. It is greener than the lemon, to which it is related. It grows on a small citrus tree. The lime tree comes from India. It now grows in the Mediterranean basin, the West Indies, Mexico, and the United States.

The lime tree rarely grows higher than 3 to 3.5 metres. The fruit is important as a source of lime juice and oil of lime, which are used to flavour beverages and food.

Scientific classification. Lime trees belong to the rue family, Rutaceae. The Persian lime is *Citrus latifolia.* The Key lime is *C. aurantiifolia.*

Lime or linden is any of a group of graceful shade trees of the Northern Hemisphere. In North America they are known as basswood (see Basswood). There are about 45 species.

In summer, limes produce clusters of small fragrant white or yellow flowers. The flowers are very attractive to bees. However, in large doses the nectar can be poisonous to bees. In Europe, the flowers are picked and used to make a herbal tea. Berrylike seeds fall from the trees in the autumn. Limes grow best in deep, moist soil, but can survive in dry areas. They are hardy trees, affected by few serious plant diseases. Limes also suffer little damage from air pollution and thus thrive in cities.

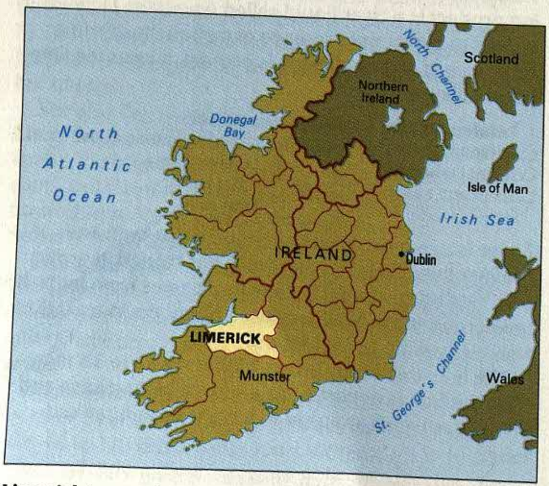
The light-coloured wood of lime trees is used to make piano keys, furniture and cooking utensils. The wood is easy to work and is popular material for carvings. Lime trees are widely planted as ornamental trees. The main boulevard of *Unter den Linden* in Berlin, Germany gets its name from the many lime trees that line its street.

Scientific classification. Lime trees or lindens belong to the family Tiliaceae.

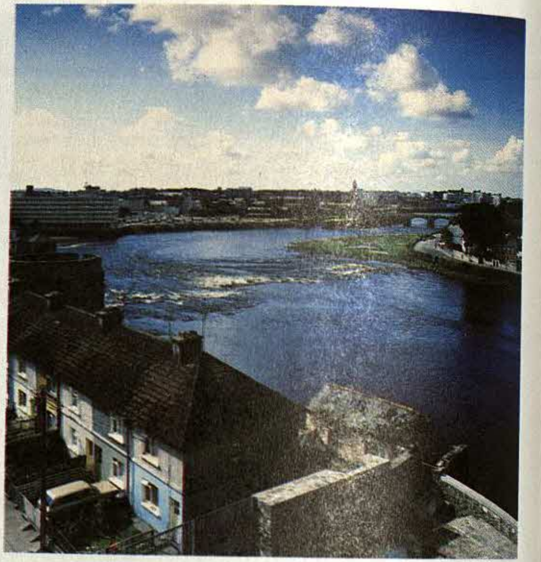
Limerick is a county located along the estuary of the River Shannon in the southwest of the Republic of Ireland. It is one of the six counties in the province of Munster. Almost half of the population lives in and around the city of Limerick. It is the third largest city in the Irish Republic and the biggest in the western part of the state. Much of the remainder of the county consists of green pastures and meadows. Limerick is noted for its intensive dairy farming.

People and government. The population of Limerick increased after 1960. The growth was most rapid in the 1970's. The increase was greatest around Limerick city, and spread across the county boundary into Clare. In the late 1980's, the county's population declined. Large numbers of people moved away from Limerick city and the rural west of the county.

About 95 per cent of the people of Limerick are Roman Catholic. Most of those of other denominations are members of the Church of Ireland, or Methodists. For both Roman Catholic and Church of Ireland, there is a diocese of Limerick with a cathedral in the city.



Limerick is a southwestern county of the Republic of Ireland and one of six counties in the province of Munster.



The River Shannon, Ireland's longest river, runs along the northern boundary of County Limerick.

There are two parliamentary constituencies in Limerick which together elect eight representatives to *Dáil Éireann* (the lower house of the Irish parliament). Local government is carried out by a county borough corporation for the city of Limerick and a county council for the rest of the county.

Economy. One-sixth of people in Limerick work in agriculture. Most farms are of medium size, averaging about 25 hectares in area. The land is less fertile in the west of the county than in the centre and east, which form part of what is called the *Golden Vale.* The soils are suitable for grass and only 1 per cent of the land is under arable crops. Dairying is the leading type of farming. Farmers rear beef cattle and there is some poultry production.

One-fourth of County Limerick's people work in manufacturing industry. Most manufacturing is in Limerick city, which is one of the main industrial centres in the Republic of Ireland. Some people who live in Limerick commute to work on the Shannon industrial estate and airport in County Clare.

Half of industrial employment is in engineering. This is mainly light industry and includes electronic engineering, household appliances and other electrical goods, machinery and metal goods, and medical and

Facts in brief about Limerick

Population: *1991 census*—161,856.
Area: 2,686 km².
Largest towns: Limerick, Newcastle West, Rathkeale, Abbeyfeale, Kilmallock.
Chief products: *Agriculture*—cattle, milk, pigs, poultry. *Other primary products*—building materials, timber. *Manufacturing*—alumina, cement, clothing, electronic and electrical goods, food products, machinery and metal goods, plastic and wood products, printed matter.
Origin of name: From the Gaelic name of the area, *Luimneach.*

optical supplies. The traditional basis of Limerick manufacturing was food processing, and this industry is still important. It includes bacon and other meat products, dairy processing, and milling. Other types of industry include the production of building materials, chemicals, clothing, furniture and wood products, and plastic goods, as well as printing and publishing. There are two other major industrial plants, one making cement near Limerick city and the other producing alumina at Aughinish on the Shannon estuary. Limerick lace is a traditional product.

Service industries account for over half the employment in Limerick. The city is the major service centre for the midwest region. Limerick services include catering, education, finance, health, public administration, retail and wholesale distribution, and transport.

Limerick city is a major educational centre. The University of Limerick was formed in 1989 from the National Institute of Higher Education. There are also *third-level* (higher education) colleges for art, business, education, music, and technology.

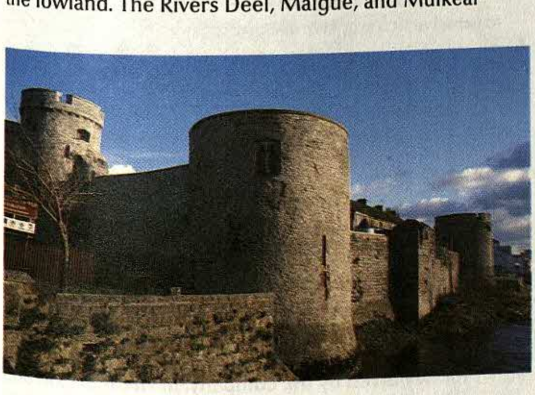
Tourism in Limerick City has benefited from being close to Shannon airport. There is a forest park at Currahchase near Askeaton.

Limerick City is a major transport centre. It is situated at the lowest point downstream where bridges can be conveniently built across the River Shannon. The national primary roads that radiate from the city within the county are the N7 to Dublin, the N24 to Waterford, the N20 to Cork, and the N21 to Tralee. A railway goes to Limerick Junction in Tipperary, where it meets the Dublin-to-Cork line. This line then passes through the southeast of County Limerick. There is a branch line to Nenagh and a freight-only line to Foynes.

County Limerick receives most of the shipping on the west coast of Ireland. The ports are the harbour of Limerick City and the deepwater ports of Foynes and Aughinish on the Shannon estuary.

Land. The Shannon estuary and river form much of the northern boundary of County Limerick. Tipperary is to the east, Cork to the south, and Kerry to the west. County Limerick is roughly rectangular in shape, measuring about 80 kilometres from east to west and 40 kilometres from north to south.

Most of County Limerick consists of rolling limestone lowland. Hills of volcanic rock and sandstone rise from the lowland. The Rivers Deel, Maigue, and Mulkear drain the lowland northward to the Shannon estuary.



King John's Castle was a fine stronghold built as part of the Limerick city defences in about 1200.

Adare is a charming village in County Limerick. These thatched, ivy-clad cottages are in the main street.

The upland areas of County Limerick all lie along its edges and are shared with other counties. They consist of sandstones, shales, and slates. The highest are the Galtee Mountains, which rise to 800 metres in the southeast. This ridge continues westward as the Ballyhoura Mountains. In the northeast are the Slievefelim Mountains. In the west, the land rises to a low plateau towards the Kerry border, with the Mullaghareirk Mountains to the south. Parts of these uplands have been planted with forest.

The yearly rainfall is about 100 centimetres. Average temperatures vary from 5° C in January to 16° C in July.

History. Evidence from the Lough Gur area shows that people were living in Limerick more than 5,000 years ago. In Gaelic times, the region was in the kingdoms of Thomond and Desmond. One of the treasures of Ireland's Celtic monastic heritage, the Ardagh Chalice, was found in western Limerick. After the Anglo-Norman invasion of the 1100's, families such as the de Burgos and FitzGeralds gained control of lands in Limerick. Hundreds of castles were built, and today Limerick has more castles dating from the Middle Ages than any other Irish county. After periods of war in the 1500's and 1600's, the British government granted lands to British settlers, but these *plantations* (settlements of colonists) had limited success.

The attractive village of Adare reflects some of the features of Limerick's history. It was a medieval foundation, and there are remains of a medieval castle, churches, and monasteries. The earls of Dunraven later remodelled the village, and built Adare Manor which is now a hotel. The road to Rathkeale passes through an area to which German settlers known as Palatines came in the early 1700's.

Limerick city was founded by the Vikings in about A.D. 900. The Anglo-Normans developed it from the late 1100's. The early settlement was on an island in the Shannon that became known as Englishtown. On it are St. Mary's Cathedral and King John's Castle, which both date from the Middle Ages. The city is famous in Irish history for the Siege and Treaty of Limerick in 1691, during the Jacobite-Williamite War. The Newtown Perry district of wide streets and Georgian houses was laid out in the 1700's. It is now the main business district.

See also **Ireland, History of.**

Limerick is a form of humorous verse. It takes its name from the city of Limerick, Ireland. No one knows how or where the form originated. The limerick is a poem of five lines, with strong beat and rough *anapaestic* rhythm (*de-de-DUMM*). It is written in *Poulter's Measure,* a Folk Metre that consists of 13 beats (see **Poetry** [Stress metres]). The first two lines rhyme with the fifth. The third line rhymes with the fourth.

Limericks may cover a wide range of subjects. The first line often begins: "There was a . . ." and ends with the name of a person or place. The last line ends with an unusual or far-fetched rhyme. Edward Lear's *A Book of Nonsense* (1846) made the form popular. The following is a typical limerick by Lear:

> There was a young lady of Wilts,
> Who walked up to Scotland on stilts;
> When they said it is shocking
> To show so much stocking,
> She answered, "Then what about kilts?"

Limerick, Treaty of, ended the war between the English kings William III and James II. The English had deposed James, a Roman Catholic, in 1688 and made William, a Protestant, king. James's supporters, called *Jacobites,* started rebelling in Ireland in 1689. William III repeatedly defeated the Jacobites until in 1691 they held only Limerick. The Jacobite forces decided to surrender, and the two sides signed the Treaty of Limerick on October 3.

The treaty gave the Jacobites three choices: to take an oath of loyalty to William and return to their homes and lands; to enlist in William's forces; or to go to France. Most of them went to France. The treaty also granted security of property and religious freedom to Catholics in Ireland. William intended to honour the treaty, but the English Parliament considered it too lenient and did not honour it. Much of the land and property of the Jacobites was later confiscated.

Grey limestone is the most common type. Limestone also occurs in many other colours.

Limestone called coquina is made up of coral and shells of marine animals.

Limestone is a type of rock made up mostly of calcite, a mineral form of calcium carbonate. Most limestone is grey, but all colours of limestone from white to black have been found. Scientists test natural rock to see if it is limestone by pouring cold diluted hydrochloric or sulphuric acid on it. Limestone gives off bubbles of carbon dioxide.

Most fresh water and sea water contain dissolved calcium carbonate. All limestones are formed when the calcium carbonate crystallizes out of solution. It leaves the solution in many ways, and each way produces a different kind of limestone. All the different kinds can be divided into two groups.

The first group includes limestones that formed almost completely without the aid of organisms. This type of limestone is forced out of solution when the water evaporates. Such evaporation takes place in the hot lagoons of many coral reefs, and in most shallow tropical seas. The high temperature causes the water on the surface to evaporate. A white "lime" mud is deposited on the bottom of the sea. This white mud slowly hardens over millions of years into a light-coloured limestone with a fine grain and even layers. Chalk is a limestone that remained soft.

When spring water evaporates on land, calcium carbonate forms a crust over moss, dead leaves, and the ground. It builds up a mound or terrace called *tufa.* Evaporation of water seeping through the roof of limestone caverns forms another variety of limestone, called travertine, into stalactites and stalagmites (see **Stalactite; Stalagmite**).

The second group of limestones forms by the work of organisms. Many animals and some water plants draw calcium carbonate out of the water and use it to make their shells and bones. The oysters, clams, snails, corals, and sea urchins do this. When the animals die, the shells and bones are broken up by waves into shell and coral sand and mud. Many of the beaches on Pacific islands are made of such coral mud and sand. Most of the limestone layers in all parts of the earth were once shell or coral sand and mud. A limestone called *coquina,* formed of shells and coral, occurs in some tropical waters. It is used to make roads and in building.

Limestone makes an excellent building stone because it can be carved easily. Like sandstone, it can be cut any way without splitting. For this reason, both limestone and sandstone are often called *freestone.* Limestone is especially good for foundations and walls where a high polish is not needed.

Some factories use limestone to clean waste gases and water before releasing them into the environment. Limestone is also used to make lime and to smelt iron ore (see **Iron and steel** [Raw materials]).

Related articles in ***World Book*** include:

Building stone
Calcite
Carbonate
Cement and concrete
Chalk
Coral
Dolomite
Lime
Marble
Quarrying
Rock (Sedimentary rock)
Travertine

Limewater. See **Lime** (Chemical).

Limitation of armaments. See **Disarmament.**

Limitations, Statute of. See **Statute of limitations.**

Limited company is a business organization in which each shareholder is responsible only for the shares he or she holds. If the company goes into debt, a person owning stock loses only the money invested to buy the stock. Creditors cannot sue the investor to recover money owed by the company. In Great Britain and many other nations, the word *Limited* (*Ltd.*) or the initials *plc* (for public limited company) after a company's name indicates that the liability of investors in the firm is limited to the amount each has invested.

In Australia, New Zealand, and South Africa, the abbreviation *Pty.* is used after the name of a private limited company.

Limnology is the scientific study of lakes, streams, ponds, and other bodies of fresh water. Limnologists study the chemical and physical characteristics of these bodies of water. They also study the plants and animals that live in fresh water, and their relationship to each other and to their environment. Limnology is related to *ecology,* the study of the relations between organisms and their environments. Limnology has special importance in the management of fish for economic and recreational purposes.

See also **Ecology.**

Limonite is a yellowish or brownish mineral deposit. It is a kind of iron ore composed of varying amounts of the minerals goethite, haematite, and lepidocrocite.

Limonite results from the breakdown and weathering of other minerals that contain iron. It may occur as a surface film on rocks, as ordinary rust, or as a slimy deposit in lakes and marshes. Limonite also may appear as the colouring material in yellow clays and soils. It is the source of *ochre,* a yellow powder used in paints and pigments.

Limonite is found in large amounts in Cuba, in eastern France, and in the Labrador Trough region of eastern Canada. *Limonite* originally referred to a type of iron deposit now called *bog iron ore.*

See also **Iron and steel** (Kinds of iron ore).

Limpet is a sea animal with a protective shell. It lives along rocky coasts in many parts of the world. Most limpets are less than 8 centimetres long, but a west Mexican limpet grows 20 centimetres in length. Limpets are easy to find at low tide. Their shells can be seen on exposed rocks, and resemble tiny saucers turned upside down. In most limpets, the shell completely covers the animal and protects it from hungry crabs and sea birds. Beneath the shell, the limpet's powerful, muscular *foot* clamps its body firmly to the rock by suction. At high tide, the limpet moves over rocks in search of seaweeds. It gathers food into its mouth with a *radula* (long ribbon-like tongue), which bears rows of teeth. Before the tide goes out, the limpet returns to its original resting place on the rock.

The limpet, a small sea mollusc, uses a muscular organ called a *foot* to cling to rocks and move about in search for food.

See also **Animal** (picture: Animals of the oceans); **Mollusc; Snail; Shell** (picture).

Scientific classification. Limpets belong to the phylum Mollusca, class Gastropoda.

Limpopo River is an important river that flows for about 1,600 kilometres in southeastern Africa (see **South Africa** [terrain map]). The Limpopo rises in the highlands and separates the Transvaal Province of South Africa from Botswana and Zimbabwe before it crosses Mozambique to the Indian Ocean. Rudyard Kipling described the river in his story, "The Elephant's Child," as "the great grey-green greasy Limpopo." It is also called the *Crocodile River.* The last 97 kilometres of the Limpopo are tidewater. Above this point, the river varies between a small trickle in the dry season and a roaring flood in the wet season. The Olifants River is the Limpopo's main tributary.

Lin Biao

Lin Biao (1907-1971), also spelled *Lin Piao,* was defence minister of China from 1959 to 1971. In the late 1960's and early 1970's, Lin was officially designated to succeed Mao Zedong, chairman of the Chinese Communist Party. But in 1971, Lin disappeared from public view. In 1972, China reported that Lin had died in an aeroplane crash in Mongolia in 1971. The crash occurred while Lin was reportedly trying to flee China after failing in an attempt to kill Mao and overthrow the government.

As defence minister, Lin headed the People's Liberation Army. For a time, he headed the Red Guards, a youth group formed in the 1960's to back Mao.

Lin was born in Hubei (or Hupeh) province. A top student under Chiang Kai-shek at the Whampoa Military Academy, Lin joined Mao's Communist forces after graduation. In 1934 and 1935, he led advance troops on the 9,700-kilometre *Long March* to escape Chinese Nationalist forces. Lin won victories over invading Japanese forces in the late 1930's and over Nationalist armies in China's civil war.

Lin Yutang (1895-1976) was a Chinese scholar and writer. He helped interpret Chinese culture to the West in such books as *My Country and My People* (1935) and *The Importance of Living* (1937). Lin wrote novels, plays, essays, and travel guides in English. His best-known novels are *Moment in Peking* (1939) and *A Leaf in the Storm* (1942). He also translated three Chinese novelettes into the collection *The Widow, Nun, and Courtesan* (1951) and edited *The Wisdom of Confucius* (1938) and *The Wisdom of China and India* (1942).

In 1932, Lin founded the magazine *The Analects,* which achieved immediate success. He was interested in Chinese language reform, and played a major role in developing a romanized system of Chinese speech sounds known as *Gwoyeu Romatzyh.* This system of sounds simplified writing in the Chinese language. Lin compiled an important Chinese-English dictionary, published in 1972.

Lin was born in Xiamen (also called Amoy). He taught at the National University of Beijing (Peking) from 1923 to 1926. After serving with the Nationalist government in 1927 and 1928, Lin devoted himself to writing and translating. He lived in the United States from 1936 to 1966 and died in Hong Kong.

Linacre, Thomas (1460?-1524), was a physician and classical scholar. He helped to found the College of Physicians in England and was its first president. He aimed to introduce the teaching of medicine into universities, and founded a readership in the subject at Oxford University. He was appointed physician to Henry VIII. During his lifetime, Linacre was better known for his classical scholarship. He translated the works of Galen and Aristotle and wrote books on Latin grammar. He taught Greek to Erasmus and Sir Thomas More.

Lincoln (pop. 81,900) is a city in eastern England. The city lies on the River Witham. Grain is grown in the region. Lincoln is a centre for the manufacture of agricultural and other machinery.

The name Lincoln derives from the Latin *Lindum Colonia.* The Romans took over the earlier Celtic settlement of Lindum soon after they invaded Britain in A.D. 43. A Roman military garrison at Lincoln controlled eastern England and protected major trade routes. Ermine Street, an important Roman road, ran past Lincoln. Lincoln grew as an agricultural town during the A.D. 200's. Newport Arch is the city's original Roman gateway.

In the Anglo-Saxon period, Lincoln became part of the kingdom of Mercia. In the 800's and 900's, Danish invaders held the city as part of the Danelaw. Lincoln's importance rose under the Normans. In 1086, William the Conqueror built a castle at Lincoln. Lincoln Cathedral was built between 1075 and 1501.

See also **Lincolnshire.**

Lincoln, Abraham (1809-1865), was president of the United States from 1861 to 1865. He led the United States during the American Civil War, which was the greatest crisis in U.S. history. He helped preserve the American Union and helped end slavery in America.

Lincoln's Gettysburg Address and his many other speeches and writings are classic statements of democratic beliefs and goals. His nobility of character won him worldwide appeal. Many have regarded Lincoln as the greatest person in U.S. history.

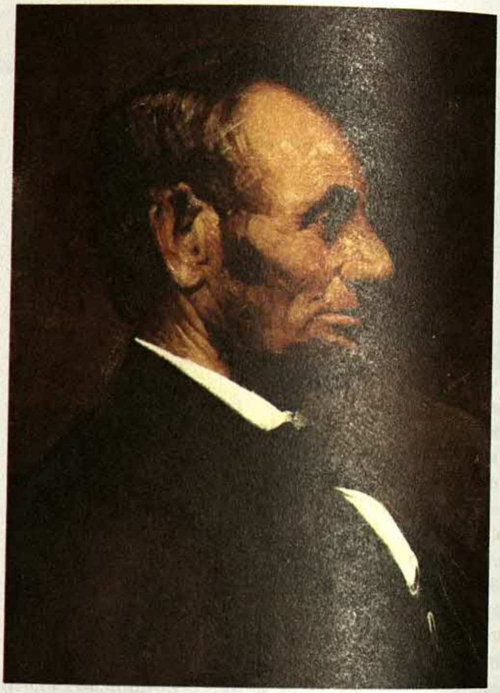
Lincoln was the first Republican to become president. He was also the first president to be assassinated.

Boyhood and youth. Lincoln was born on Feb. 12, 1809, in a log cabin near Hodgenville, Kentucky, U.S.A. In 1816, his family moved to Indiana. Abraham received hardly any formal education but loved reading when he could get hold of a book.

In 1830, Lincoln's father, Thomas Lincoln, took the family west to Illinois. Abraham himself moved out of the family home and settled briefly in the Illinois village of New Salem.

Lincoln won election as a Whig politician in 1834 (see **Whig Party**). He served four successive two-year terms in the lower house of the Illinois General Assembly.

In 1834, a lawyer called John Stuart urged Lincoln to study law. Lincoln borrowed law books from Stuart and studied them. He sometimes walked the 32 kilometres from New Salem to Stuart's office for books. In 1836, Lincoln embarked on a highly successful career as a lawyer based in the Illinois state capital of Springfield. He eventually founded his own firm in 1846. Abraham Lincoln married Mary Todd in 1842.



Abraham Lincoln led the United States during the Civil War—the greatest crisis in U.S. history.

National politics. In 1846, Lincoln was elected to the U.S. House of Representatives, but failed to make his mark. In 1849, he failed to get an appointment as Commissioner of the General Land Office. President Zachary Taylor, a fellow Whig, offered him other political offices, but he refused them.

The slavery controversy. A sudden change in national policy toward slavery brought Lincoln back into the centre of political activity in Illinois. A law called the Missouri Compromise of 1820 had prohibited slavery in new territories north of an east-west line that was an extension of Missouri's northern boundary. Early in 1854, Senator Stephen Douglas of Illinois, a Democrat, introduced a bill to organize the territories of Kansas and Nebraska into new states. The Kansas-Nebraska Act repealed the Missouri Compromise. It provided that the settlers of new territories should decide for themselves whether they wanted slavery.

Lincoln and many others had believed that slavery

Important dates in Lincoln's life

1809	(Feb. 12) Born near present-day Hodgenville, Kentucky.
1834	Elected to the Illinois General Assembly.
1842	(Nov. 4) Married Mary Todd.
1846	Elected to the U.S. House of Representatives.
1858	Debated slavery with Stephen A. Douglas.
1860	(Nov. 6) Elected president of the United States.
1864	(Nov. 8) Reelected president.
1865	(April 14) Shot by John Wilkes Booth.
1865	(April 15) Died in Washington, D.C.

had been permanently limited by the Missouri Compromise and would in time die out. Lincoln considered that the Kansas-Nebraska Act gave new life to slavery, and it outraged him.

Lincoln opposed slavery, but he believed that to ban it immediately throughout the United States might risk the breakup of the Union. He felt that slavery should have the protection that the Constitution gave it in the old territories south of the Missouri Compromise line. But he opposed its extension to the new states because he considered it to be evil. Facing opposition from supporters of slavery such as Douglas, Lincoln sought to reverse the Kansas-Nebraska Act. In 1854, after retaining his seat in the Illinois legislature, Lincoln resigned and stood for the U.S. Senate. He was unsuccessful.

The Whig Party began falling apart in the 1850's, largely because of disagreement on a solution to the slavery problem. In 1856, Lincoln joined the antislavery Republican Party, then only two years old. In 1858, he ran against Douglas for the U.S. Senate. Douglas defeated Lincoln by 54 votes to 46. But Lincoln emerged as a national figure after a series of historically important public debates with Douglas on the slavery issue.

Election of 1860. At the 1860 Republican national convention in Chicago, Lincoln won the party's presidential nomination on the third ballot. His opponents for the presidency were Douglas, selected by the Northern Democrats after angering the proslavery southern wing of the Democratic Party when he failed to support a proslavery U.S. Constitution; Vice President John Beckinridge, the proslavery Democratic candidate; and John Bell of the Constitutional Union Party.

Lincoln won the election easily, receiving 180 electoral votes to 72 for Breckinridge, 39 for Bell, and 12 for Douglas. But the people only gave Lincoln 1,865,908 votes, compared to 2,819,122 altogether for his opponents.

Lincoln as president. On Dec. 20, 1860, South Carolina withdrew from the Union of American States by passing an Ordinance of Secession. By the time Lincoln took up the presidency, six other Southern States had withdrawn from the Union. Four more states followed later. The seceded states organized themselves into the Confederate States of America.

On March 4, 1861, Lincoln took the oath of office and became president of the United States. In his inaugural address, he denied that he had any intention of interfering with slavery in states where the Constitution protected it. He urged the preservation of the Union. And he warned that he would use the full power of the nation to keep control of the forts, arsenals, and customs houses of the federal (Union) government.

The Civil War. In April 1861, Confederate troops captured the Union garrison of Fort Sumter in Charleston, South Carolina. This signalled the start of the American Civil War. Lincoln met the crisis with energetic action. He called on the militia, proclaimed a blockade of Southern parts, and expanded the army. He suspended the *writ of habeas corpus* (a basic protection against unjust detention by authorities). He also ordered the spending of government funds without waiting for approval by the Congress.

As commander in chief of the Union's army, Lincoln had to select an officer capable of organizing untrained volunteers and leading them to victory. His first four choices proved costly failures, and Union forces suffered several defeats during the first year of the war. Lincoln eventually found a general who could win battles in Ulysses S. Grant.

Organization for military success was only one of Lincoln's tasks. He also had to arouse popular support for the Union armies. Different opinions among the people became plain after their first enthusiasm wore off. Most Northerners were willing to fight to preserve the Union, but not to destroy slavery. But other Northerners demanded an end to slavery.

Lincoln realized that the border states would secede if the antislavery extremists had their way. The loss of such states—Kentucky, Missouri, Delaware, and Maryland—would have made the task of defeating the South much harder. The Constitution, moreover, protected slavery in the states where it existed. Lincoln's moderate position helped keep the border states in the Union, and Lincoln also managed to keep the support of most Northerners.

Foreign relations. While meeting his other challenges, Lincoln managed to keep a check on foreign policy. In November 1861, Captain Charles Wilkes of the U.S. Navy stopped the British ship *Trent* and removed two Confederate commissioners, James Mason and John Slidell. The British angrily demanded the release of the two men, threatening war to support their demand. The United States later freed Mason and Slidell, and Lincoln avoided a war with Britain.

The Emancipation Proclamation. By late summer of 1862, Lincoln was convinced that the time had come for a change in policy toward slavery. More Northerners were coming round to a rejection of slavery because it was a social evil. Lincoln decided to issue a proclamation freeing the slaves. On the advice of Secretary of State William Seward, he withheld the proclamation until a Northern victory created favourable circumstances.

The Lincolns had three sons who lived past infancy. Shown *left to right* are William, Robert, and "Tad." Only Robert lived to adulthood, however. William died at age 11, and Tad at age 18.

The Battle of Antietam, fought on Sept. 17, 1862, served Lincoln's purpose. He issued a preliminary proclamation five days later. He declared that all slaves in states, or parts of states, that were in rebellion on Jan. 1, 1863, would be free. He issued the final proclamation on January 1, naming the states in rebellion and declaring that the slaves held there "are, and hence-forward shall be, free."

Actually, the proclamation freed no slaves. It applied only to Confederate territory, where federal officers could not enforce it. The proclamation did not affect slavery in the loyal border states. Lincoln repeatedly urged those states to free their slaves and to pay the owners for their loss. He promised financial help from the federal government for this purpose. But the states did not heed his plea. Yet the proclamation gave a new character to the war, which now became a fight against slavery. It also paved the way for the 13th Amendment to the Constitution (1865) which ended slavery in all parts of the United States.

The Gettysburg Address. Union armies won two great victories in 1863, at the battle of Gettysburg, Pennsylvania, and Vicksburg, Mississippi. On Nov. 19, 1863, ceremonies were held to dedicate a cemetery on the Gettysburg battlefield. The principal speaker was Edward Everett, one of the greatest orators of his day. He spoke for two hours. Lincoln was asked to say a few words, and spoke for about two minutes. Lincoln's short Gettysburg Address, with its ringing declaration that "government of the people, by the people, for the people, shall not perish from the earth," is probably Lincoln's most famous speech.

In March 1864, Lincoln put General Grant in command of all the Union armies. The Union army in the east, the Army of the Potomac, started to march toward Richmond two months later. At the same time, General William Sherman began his famous march from Tennessee through Confederate Georgia to the sea.

Election of 1864. In 1864, Republicans and War Democrats—Democrats who supported Lincoln's military policies—formed the National Union Party, which nominated Lincoln for president. Several Union victories in the late summer and early autumn helped Lincoln win reelection. He defeated his Democrat opponent, General George McClellan, by 212 to 21 electoral votes and a popular majority vote of more than 4,000.

The end of the war was clearly in sight when Lincoln took the oath of office a second time, on March 4, 1865. Grant was besieging Confederate General Robert E. Lee's weary troops at Petersburgh, Virginia. On April 9, 1865, Lee surrendered to Grant at Appomattox Court House in Virginia. Under authority from Lincoln, Grant extended generous terms to Lee and his army. A great wave of joy swept the North when the fighting ended.

On April 11, 1865, Lincoln delivered his last public address. In it, he spoke soberly of the future. Louisiana had applied for readmission to the Union under Lincoln's plan of reconstruction. Many Northerners wanted to impose harsher terms on the state. Many also insisted that Lincoln decide if "the seceded states, so called, are in the Union or out of it." The president said of the seceded states, that, "finding themselves safely at home, it would be utterly immaterial whether they had ever been abroad." He welcomed them back to the Union.

Assassination. On the evening of April 14, 1865, Lincoln attended a performance of the play *Our American Cousin* at Ford's Theater in Washington. A few minutes after 10 o'clock, John Wilkes Booth, a well-known actor of the day and a Southern sympathizer, shot the president in the head from the rear of the presidential box. Lincoln was carried unconscious to a neighbouring house. He died at 7:22 a.m. on April 15, 1865.

In leaping to the stage, Booth caught his spur in a flag draped in front of the box. He fell and broke his leg. But he limped across the stage brandishing a dagger and crying, "Sic semper tyrannis" (Thus always to tyrants), the motto of Virginia. Booth fled the theatre and made his way to Virginia, where on April 26, Federal troops killed him in a barn at Port Royal.

Lincoln had been a remarkable war leader. By preserving the Union, he influenced the course of world history. If the Union had been destroyed, the United States could have become two, or possibly more, nations.

Related articles in ***World Book*** include:

Abolition movement
American Civil War
Booth, John Wilkes
Davis, Jefferson
Gettysburg Address
Grant, Ulysses S.
Johnson, Andrew
Slavery

Lincoln, Saint Hugh of. See Hugh of Lincoln, Saint.

Lincoln's Inn. See Inns of Court.

Lincolnshire is a county situated midway along England's eastern seaboard. Its flat land supports every kind of farming activity and makes Lincolnshire a rich agricultural county noted for its pleasant meadows, small villages, and historic churches.

In 1974, Lincolnshire was reduced in size. The northern part of the county, including Grimsby and Scunthorpe, was taken into a new county called Humberside. Before 1974, Lincolnshire had been administered as three separate counties called *parts.* They were the Parts of Holland, Parts of Kesteven, and Parts of Lindsey. The parts were abolished in 1974.

People and government

The main occupations in Lincolnshire are in agriculture or related industries. Some manufacturing industries have grown up round the three main towns and have attracted some workers away from farming.

Local customs and legends. A number of old customs are carried on in Lincolnshire. For example, North Somercotes holds a pancake race on Shrove Tuesday. A modern custom attracts thousands of visitors to Spalding in early May. A parade of floats passes through the town, decorated with more than six million flowers.

Facts in brief about Lincolnshire

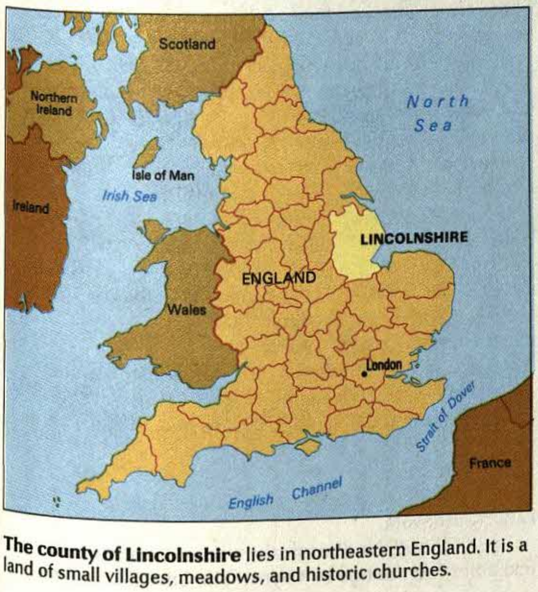
Administrative centre: Lincoln.
Largest towns: Lincoln, Grantham, Boston, Gainsborough, Spalding, Stamford.
Area: 5,885 km^2.
Population: *1991 census*—573,900.
Chief products: *Agriculture*—barley, beef, bulbs, dairy products, potatoes, sugar beet, trees, vegetables, wheat. *Manufacturing and processing*—agricultural chemicals, agricultural machinery, beer, bricks, clothing, diesel engines, flour, glue, leather goods, malt, plastics goods, road rollers. *Quarrying*—chalk, iron ore, limestone, sand and gravel.

Lincoln centres on Steep Hill, which is dominated by Lincoln Cathedral. The cathedral stands near a Norman castle that was built by William the Conqueror.

Recreation. Fishing is one of the county's most popular sports. Several wild fowl clubs organize shooting on the salt marshes. But a large area at Gibraltar Point, near Skegness, is a bird sanctuary. Tattershall gravel pits have facilities for speed-boat racing. Thorpe-on-the-Hill has water-skiing facilities.

Horses race on the racecourse at Market Rasen. The county has a number of annual gymkhanas. There are six packs of hounds for fox hunting. Lincoln has a soccer team in the Football League.

Local government. Up to April 1996, Lincolnshire contained seven administrative districts—*Boston; East Lindsey,* including Skegness; *Lincoln; North Kesteven,* including Grantham and Sleaford; *South Holland,* including Spalding; *South Kesteven,* including Bourne and Stamford; and *West Lindsey,* including Gainsborough. Lincolnshire County Council provided some public services throughout the county. In 1996, the UK government planned to replace district councils and some county councils with bodies called *unitary authorities.*



The county of Lincolnshire lies in northeastern England. It is a land of small villages, meadows, and historic churches.

Economy

Agriculture and mining. The county's main crop is sugar beet. Peas and other vegetables are grown for freezing and canning. Potatoes are grown in many parts of the county, and barley and wheat are particularly important in northern Lincolnshire.

Many farmers keep dairy and beef cattle, including the Lincoln Red. There are some flocks of Lincolnshire Longwool sheep, but most sheep are crossbreeds. Some farmers keep poultry or pigs. There are areas of managed woodland at Laughton and Willingham. The Holland area is famous for its bulbs.

Quarries produce iron ore and chalk at Nettleton. The iron ore beds extend for about 16 kilometres to Walesby, near Market Rasen. Welton has an oilfield.

Manufacturing. Lincoln's industries include engineering, iron founding, and flour milling. The city produces agricultural chemicals and machinery, bricks, diesel engines, and tinned vegetables.

Grantham has a large industrial estate built on a disused Royal Air Force base. The town has engineering industries, with products including diesel road rollers. Other local products include beer, clothing, flour, glue, leather and shoes, and malt. Gainsborough's main industries are connected with engineering. The town's workers also produce fertilizer, malt, and clothing.

Tourism. The sandy shores and dunes along Lincolnshire's coast attract many tourists. The main holiday resorts are Mablethorpe, Skegness, and Sutton-on-Sea.

Transportation and communication. The most important road passing through the county is the Great

Places to visit

Following are brief descriptions of some of the interesting places to visit in Lincolnshire:

Corby, near Grantham, has important medieval wall paintings in its church. The paintings were discovered in 1939.

Grantham has a magnificent parish church which includes a library of chained books, the oldest of which dates from 1472. Grantham Museum has displays of local history.

Lincoln Cathedral dates from 1192. An outstanding feature is the Dean's Eye, a rose window dating from the 1200's. The city has a number of other medieval buildings.

Stamford is architecturally a fine town. It has several ancient churches and almshouses.

Tattershall Castle was built in about 1440 by Ralph Cromwell, Treasurer of England. The guard house is now a museum.

Woolsthorpe Manor, near Colsterworth, was the birthplace of Sir Isaac Newton. In Colsterworth church is a sundial carved by Newton when he was 9 years old.

North Road, the A1. A main railway from London to Doncaster passes through Grantham, and an important branch line runs through Lincoln and Market Rasen.

A daily newspaper is published in Lincoln. The county has a number of weekly newspapers. Local radio stations serve the county.

Land

Location and size. The county stretches about 105 kilometres from north to south and about 80 kilometres from east to west. In the north, Lincolnshire borders on Humberside; in the west, Nottinghamshire and Leicestershire; and in the south, Cambridgeshire and Norfolk. The county's coastline faces the North Sea and includes the inlet called *The Wash.*

Land regions. Lincolnshire is divided into four natural regions—the fens, the heath, the wolds, and the marsh. The fens are principally in southeastern Lincolnshire. Drains and banked canals remove excess water, leaving rich and fertile soils.

The county is not entirely flat. On its western side, it is hilly from Stamford in the south to the boundary with Humberside in the north, where cliffs reach 67 metres.

The wolds lie to the east of the heath. They extend northwestward from Spilsby. The wolds rise to 167 metres above sea level. The marsh district lies between the wolds and the sea. It is a tongue of flat and fertile land about 14 kilometres wide.

Rivers. Lincolnshire's main rivers are the Witham and the Welland. The Witham is entirely within Lincolnshire. The Welland forms part of the county's southern border, and most of its course is outside Lincolnshire.

The River Trent forms part of the northwestern boundary of the county. It then flows for about 32 kilometres through the county of Humberside and empties into the River Humber.

Climate. Lincolnshire is a relatively dry county, but its brooks, canals, ditches, and rivers keep the land well watered. The average annual rainfall at Lincoln is about 635 millimetres. The average temperature for the county during July is about 16 °C, and in January about 4 °C.

History

Iron-Age Celts occupied Lincolnshire's upland areas in ancient times. The Romans tried to drain the low-lying ground. Important Roman roads crossed the area, and a Roman settlement, Lindum Colonia, was established at Lincoln. Danes invaded the region in the 800's and established such settlements as Stamford. Agriculture made Lincolnshire prosperous in the Middle Ages, but after the coming of industry to other parts of England in the 1800's, the county lost some of its importance.

Personalities associated with Lincolnshire include the scientist Sir Isaac Newton, the poet Alfred, Lord Tennyson, and the explorers George Bass, Matthew Flinders, and Sir John Franklin. Margaret Thatcher, the United Kingdom's first woman prime minister, was born in Grantham.

Related articles in *World Book* include:

Fens
Franklin, Sir John
Humberside
Lincoln
Newton, Sir Isaac
Roman roads
Smith, John
Tennyson, Lord
Wash, The
Wesley, Charles
Wesley, John
Wolds

Lind, James. See **Nutrition** (History).

Lind, Jenny (1820-1887), a Swedish soprano, became one of the most famous singers of the 1800's. She had a brilliant career in opera and on the concert stage. Her rich and warm coloratura voice and her remarkable vocal control won for her the title "the Swedish nightingale" from an adoring public.

Lind was born in Stockholm. She made her debut in 1838 as Agathe in *Der Freischütz.* Three years later she went to Paris to study, and then travelled to Dresden, Germany, to perfect her knowledge of German.

After 1849, Lind gave up her career as an opera singer. From 1850 to 1852, she toured the United States, part of the time under the management of showman P. T. Barnum (see **Barnum, P. T.**). Lind died in Malvern, Worcestershire, England.

Lindbergh, Anne Morrow (1906-   ), is an American poet and essayist. Her husband was the famous American aviator Charles Lindbergh (see **Lindbergh, Charles Augustus**).

Anne Morrow Lindbergh is perhaps best known for two books. One is *Gift from the Sea* (1955), a collection of eight essays about the meaning of a woman's life. The other is *The Unicorn and Other Poems, 1935-1955* (1956). Some critics attacked this work as sentimental, but others defended it as sensitive and deeply felt.

Lindbergh was born in Englewood, New Jersey. Her father, Dwight Morrow, was a famous American diplomat. After her marriage in 1929, she became a licensed pilot and made many long flights with her husband. These trips furnished material for two of her books, *North to the Orient* (1935) and *Listen! The Wind* (1938).

Lindbergh's other writings include *Dearly Beloved* (1962), *Earth Shine* (1969), *Bring Me a Unicorn* (1972), *Hour of Gold, Hour of Lead* (1973), *Locked Rooms and Open Doors* (1974), *The Flower and the Nettle* (1976), and *War Within and Without* (1980).

Lindbergh, Charles Augustus (1902-1974), an American aviator, made the first solo nonstop flight across the Atlantic Ocean on May 20-21, 1927. Other pilots had crossed the Atlantic before him. But Lindbergh was the first person to do it alone nonstop.

Early life. Lindbergh was born on Feb. 4, 1902, in Detroit, Michigan, U.S.A. He grew up on a farm near Little Falls, Minnesota.

In childhood, Lindbergh showed exceptional mechanical ability. At the age of 18 years, he entered the University of Wisconsin to study engineering. However, he left after two years to become a *barnstormer* (a pilot who performed daredevil stunts at fairs).

In 1924, Lindbergh joined the United States Army to be trained as an Army Air Service Reserve pilot. After his training he got a job flying mail between St. Louis, Missouri, and Chicago.

His historic flight. In 1919, a New York City hotel owner named Raymond Orteig offered 25,000 U.S. dollars to the first aviator to fly nonstop from New York to Paris. Several pilots were killed or injured while competing for the Orteig prize. By 1927, it had still not been won. Lindbergh believed he could win it if he had the right aeroplane. He persuaded nine St. Louis businessmen to help him finance the cost of a plane. Lindbergh chose Ryan Aeronautical Company of San Diego to manufacture a plane, which he helped design. He named it the *Spirit of St. Louis.* On May 10-11, 1927, Lindbergh tested the plane by flying from San Diego to New York City, with an overnight stop in St. Louis. The flight took 20 hours 21 minutes, a transcontinental record.

On May 20, Lindbergh took off in the *Spirit of St. Louis* from Roosevelt Field, near New York City, at 7:52 a.m. He landed at Le Bourget Field, near Paris, on May 21 at 10:21 p.m. Paris time. Thousands of cheering people met him. He had flown more than 5,790 kilometres in 33½ hours.

Lindbergh's heroic flight thrilled people throughout the world. He was honoured with awards, celebrations, and parades. President Calvin Coolidge gave Lindbergh the Congressional Medal of Honour and the first Distinguished Flying Cross medal in American history.

In the years that followed, Lindbergh flew all over the United States helping to promote aviation. He also flew to Latin American countries on goodwill visits for the U.S. government. In Mexico, he met Anne Spencer Morrow, the daughter of Dwight Morrow, the U.S. ambassador there. Lindbergh married her in 1929. He taught her to fly, and together they flew on several expeditions, charting new routes for various United States airlines. See **Lindbergh, Anne Morrow.**

Charles Lindbergh made the first solo transatlantic flight aboard the Spirit of St. Louis, a plane of his own design.

The Lindbergh kidnapping. On March 1, 1932, the Lindberghs' 20-month-old son, Charles Augustus, Jr., was kidnapped from the family home in New Jersey. About ten weeks later, his body was found. In 1934, police arrested a carpenter, Bruno Richard Hauptmann, and charged him with the murder. Hauptmann was convicted of the crime. He was executed in 1936.

The press sensationalized the tragedy. Reporters, photographers, and curious onlookers pestered the Lindberghs constantly. In 1935, after the Hauptmann trial, Lindbergh, his wife, and their 3-year-old son, Jon, moved to Europe in search of privacy and safety.

World War II. While in Europe, Lindbergh toured the aircraft industries of France and Germany. The highly advanced aviation industry of Nazi Germany impressed him greatly. In 1938, Lindbergh accepted a German medal of honour from the high-ranking Nazi official Hermann Goering. The incident caused an outcry in the United States among opponents of the Nazis.

The Lindbergh family returned to the United States in 1939. Lindbergh became a vocal supporter of the America First Committee, an organization which opposed America's voluntary entry into World War II. Some Americans accused him of being a Nazi sympathizer, and a public verbal attack by President Roosevelt forced Lindbergh to resign his Army Air Corps commission.

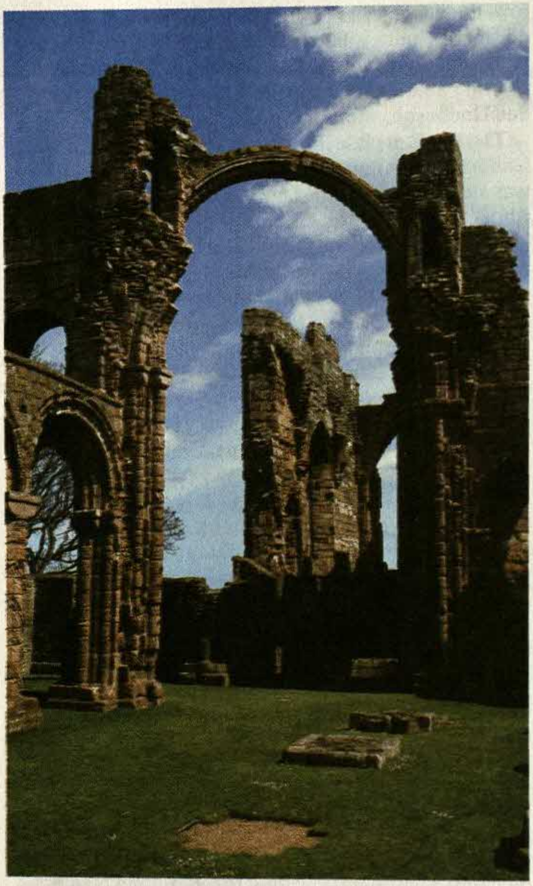
After the Japanese attack on Pearl Harbor in 1941, Lindbergh ceased his antiwar activities. He was refused leave to reenlist in the U.S. army and instead served as a technical adviser and test pilot to two aircraft builders. In April 1944, he went as technical adviser to the Pacific war zone and, although a civilian, flew about 50 combat missions.

After the war, Lindbergh withdrew from public attention. He worked as a consultant to the chief of staff of the U.S. Air Force. President Dwight D. Eisenhower restored Lindbergh's commission and appointed him a brigadier general in the U.S. Air Force in 1954. Pan American World Airways also hired Lindbergh as a consultant. He advised the airline on its purchase of jet transports and eventually helped design the Boeing 747 jet. In 1953, Lindbergh published *The Spirit of St. Louis,* an expanded account of his 1927 transatlantic flight. The book won a Pulitzer Prize in 1954.

During the 1960's, Lindbergh spoke out on behalf of the conservation movement. He especially campaigned for the protection of whales in danger of extinction.

Lindisfarne is a small island located about 5 kilometres off the coast of northern Northumberland, England. It is about 5 kilometres long and 3 kilometres wide, and lies about 16 kilometres southeast of Berwick-upon-Tweed. The island is connected with the mainland at low tide. It is also known as *Holy Island.* The island is an area of exceptional beauty. It has the ruins of an abbey founded by St. Aidan in 635, and of a Benedictine priory church built in 1093. Lindisfarne is a nature reserve.

In the late 600's, the monks of Lindisfarne prepared a beautiful manuscript containing a Latin version of the gospels. The *Lindisfarne Gospels* (now in the British Li-



Lindisfarne, or *Holy Island,* is famous for its beauty and its picturesque ruins. Lindisfarne Priory was built in 1093.

brary in London) was later taken to Chester-le-Street, near Durham, for safekeeping during Viking raids. There, in 970, St. Aldred added between the lines of the Latin manuscript a translation into the Northumbrian dialect of Old English.

See also **Holy Island.**

Lindrum, Walter (1898-1960), was an Australian billiards player who dominated his sport for almost 20 years. He first became world billiards champion in 1932, and held the title until 1950, when he retired unbeaten. During this time, many players challenged him, but none succeeded in defeating him.

At one stage in his career, Lindrum gave the next best players in the world starts of at least 7,000 points. In 1932, he scored his world record of 4,137 points in only 2 hours 55 minutes. By 1950, he held 57 world records. By giving exhibitions throughout the world, Lindrum raised vast sums of money for charity. He was born at Kalgoorlie, in Western Australia.

Lindsay is the name of an Australian family of talented artists and writers. They include three brothers—Lionel, Norman, and Daryl—all born at Creswick, Victoria.

Sir Lionel Lindsay (1874-1961) won an international reputation as an etcher, wood engraver, and watercolourist. He began his career in Melbourne as a newspaper illustrator. Later, he was a journalist and art critic.

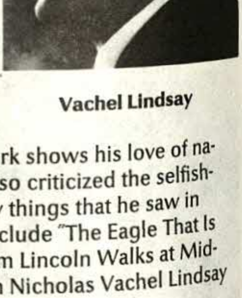
Norman Lindsay (1879-1969) became known for his pen drawings, watercolours, and oil paintings. He also achieved a reputation as a cartoonist, illustrator, novelist, and critic. He wrote and illustrated a popular book for children, *The Magic Pudding* (1919). For many years, he worked for *The Bulletin,* a Sydney magazine. His novels include *Redheap* (1930) and *Saturdee* (1933).

Sir Daryl Lindsay (1890-1976), became known for his studies of ballet dancers and landscapes in watercolour. He was director of the National Gallery of Victoria from 1942 to 1956. During World War I (1914-1918), he was a war artist.

Lindsay, David (1856-1922) was an Australian explorer. He opened up many unexplored regions of South Australia and the Northern Territory. He gained a special reputation for his bushcraft. Lindsay was born at Goolwa, in South Australia. He became surveyor general of the Northern Territory in 1878.

Lindsay, Howard (1889-1968), was an American playwright best known for the several plays he wrote with Russel Crouse. Lindsay and Crouse won the 1946 Pulitzer Prize for their political satire, *State of the Union* (1945). Their comedy *Life with Father* (1939) became the longest-running nonmusical play in American theatre history. Lindsay starred in it with his wife, Dorothy Stickney. He was also a producer and director. He was born in Waterford, New York.

Lindsay, Vachel (1879-1931), was an American poet. He believed that poetry should be performed rather than simply read. Some of his poems, such as "The Congo" (1914), even include stage directions. Among his other effective stage pieces were "General William Booth Enters into Heaven" (1913) and "The Ghosts of the Buffaloes" (1917). Lindsay often took long walking tours through the countryside. He read aloud from his works in exchange for food and shelter.



Vachel Lindsay

Lindsay's poems feature strong rhythms and vivid images. He often wrote about baseball players, circus performers, politicians, and film stars. Much of his work shows his love of nature and democracy. But he also criticized the selfishness and emphasis on worldly things that he saw in America. His critical poems include "The Eagle That Is Forgotten" (1913) and "Abraham Lincoln Walks at Midnight" (1914). Lindsay was born Nicholas Vachel Lindsay in Springfield, Illinois.

Lindsay of Birker, Lord (1879-1952) was a Scottish philosopher and scholar. His books include *The Philosophy of Bergson* (1911), *The Essentials of Democracy* (1929), *The Two Moralities* (1940), and a translation of Plato's *Republic.* He taught philosophy at Manchester University and Glasgow University. He was Master of Balliol College, Oxford, for many years, and later became head of the University College of North Staffordshire. Lord Lindsay was born in Glasgow and named Alexander Dunlop Lindsay.

Line. See Fishing (Lines).

Line, in geometry, may be described as the track of a moving point. It has no breadth or thickness. Lines may be parallel, oblique, perpendicular, and they may be straight or curved. A straight line may be a *line segment* with two ends, a *ray* with one end, or an *endless line* with no ends. See also **Geometry; Skew line.**

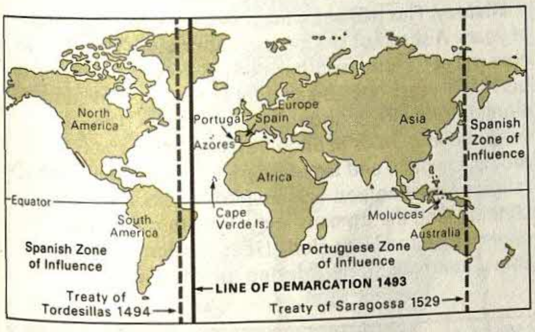
Line engraving. See **Photoengraving and photolithography.**

Line Islands, also called the Equatorial Islands, consist of 11 isolated, low coral islands in the central Pacific Ocean. The Line Islands lie on both sides of the equator. They have an area of 576 square kilometres and a population of about 2,598. For location, see **Kiribati** (map).

Three of the Line Islands—Jarvis, Kingman Reef, and Palmyra—are possessions of the United States. The eight other islands of the Line Island chain are part of the nation of Kiribati. They are Caroline, Flint, Kiritimati, Malden, Starbuck, Tabuaeran, Teraina, and Vostok. Kiribati is an island nation that also includes the Gilbert Islands and the Phoenix Islands, and Banaba.

See also **Kiribati; Kiritimati Atoll.**

Line of Demarcation was an imaginary line drawn by Pope Alexander VI to settle land rights. The line was drawn in 1493, after Christopher Columbus returned from his first voyage to the Americas. The Pope hoped it would prevent disputes between Spain and Portugal over the right to explore and claim land in Asia and the Americas. The line ran from north to south about 563 kilometres west of the Azores and Cape Verde Islands. It barely touched the east coast of the South American mainland, which had not yet been discovered by Europeans. Spain was permitted to claim land to the west of the line, and Portugal could claim land to the east of the line.



The Line of Demarcation separated the Portuguese and Spanish zones of influence in the Western Hemisphere. The Treaty of Saragossa did the same in the Eastern Hemisphere.

Neither nation found this settlement satisfactory. So the next year Spain and Portugal moved the line west to a point about 2,084 kilometres west of the Cape Verde Islands, by the Treaty of Tordesillas. This supported Portugal's claim to what is now eastern Brazil. The line was never surveyed, but scholars think that it lay near the 48° west longitude line.

A continuation of the Line of Demarcation around the globe and into the Eastern Hemisphere gave Portugal the right to claim the Philippine Islands. Spain recognized this claim in the Treaty of Saragossa in 1529, which set the line 17° east of the Moluccas (Spice Islands). In later treaties with Spain, Portugal gave up its claim to the Philippines and won the rest of Brazil. But Portugal and Spain could not secure all the newly discovered lands, because France, England, and the Netherlands ignored the Line of Demarcation and claimed territory for themselves.

Linear accelerator is a device that accelerates electrons, protons, and other electrically charged atomic particles to high energies. It is a *particle accelerator* that makes particles move along a straight line. The device is sometimes called a *linac,* a shortened form of *lin*ear *ac*celerator. Linear accelerators and other particle accelerators are often called *atom smashers.*

Physicists developed linear accelerators in order to study the structure and forces of the atomic nucleus. The first accelerator to smash atoms was built in 1932 by the British physicist Sir John Cockcroft and the Irish physicist Ernest Walton.

Linear accelerators vary according to the way they speed up particles. In one type of accelerator, called the *standing-wave linear accelerator,* particles travel down a cylindrical vacuum tank through a series of pipes called *drift tubes,* separated by gaps. As the particles cross the gaps, electromagnetic waves, called *standing waves,* accelerate them. The waves provide an electric field that speeds up the particles by acting on their electric charges. The drift tubes cause the particles to coast from one gap to the next without losing speed.

Another type of linear device, called the *travelling-wave linear accelerator,* speeds particles through a single long pipe by an electromagnetic wave that travels with the particle. This high-frequency wave is called a *travelling wave.* An alternating electric field at the front of the wave is in the proper direction to accelerate the particles to increasingly higher energies. As long as the wave speed matches the particles' speed, the particles will continue to gain energy.

Standing-wave linear accelerators are primarily used to provide particles for other more powerful accelerators, such as *proton synchrotrons* (see **Synchrotron**). The largest linear devices of this type can accelerate particles to energies of up to 200 million electronvolts. Travelling-wave linear accelerators are used mainly for scientific research into the forces that hold the nucleus of the atom together. They are also used as powerful X-ray machines in industry and medicine.

The world's largest, most powerful travelling-wave linear accelerator is in the United States at the Stanford Linear Accelerator Center (SLAC). This device can speed up electrons to 30 billion electronvolts. It is used to aim the particles at a fixed target of stationary atomic nuclei or to deliver the particles to two *storage rings.* Particles in the storage rings can be made to collide head-on. Such collisions release many times as much energy as fixed-target bombardments do. The Stanford accelerator also can be operated as the SLAC Linear Collider (SLC). The SLC can produce two 50-billion-electronvolt beams, one of electrons and the other of *positrons* (see **Antimatter**). It then guides the beams along curved paths into a head-on collision with each other. The collision produces *uncharged weak bosons* (see **Boson**). These subatomic particles carry the *weak nuclear force,* which acts within the nuclei of atoms. Scientists study the bosons to gain a greater understanding of the weak nuclear force.

See also **Particle accelerator; Cancer** (Radiation therapy); **Electromagnetic waves; X rays.**

Linear electric motor is a device used mainly to propel high-speed vehicles that do not run on wheels. Such vehicles are supported by magnets or by a cushion of air. Linear electric motors are also used to open and close gates and to operate rocket launchers and moving walkways.

The heart of a linear electric motor is a row of electromagnets that are turned on and off one after the other. This action produces a moving wave of magnetism that travels along the electromagnets just as a wave travels in water. This magnetic wave propels the vehicle.

There are two types of linear electric motors: (1) *linear induction,* and (2) *linear synchronous.*

In a linear induction motor, the row of electromagnets is located in the vehicle. The magnets face a strip of nonmagnetic metal, called a *reaction rail,* mounted in the centre of the vehicle's *guideway* (track). The moving magnetic wave *induces* (creates) an electric current in the reaction rail. The induced current produces another magnetic field that pushes against the magnetic wave from the electromagnets. This push moves the vehicle.

In a linear synchronous motor, the vehicle's electromagnets interact with magnetic coils attached to the guideway to create a moving magnetic wave. This magnetic wave propels the vehicle just as an ocean wave pushes a surfboard. The speed is proportional to the frequency of the moving magnetic wave.

Linear measure. See **Weights and measures** (table: Length and distance).

Linen is the yarn or cloth made from fibres of the flax plant. The fibres measure from 15 to 100 centimetres long and are chiefly from the woody part of the plant.

Linen fabrics. Flax ranks among the strongest natural fibres. It is used in a variety of products that require high strength, including sewing thread, fish nets, fire hose, and mattress covers. However, flax is not as strong as such synthetic fibres as nylon and polyester, which are used today in many of these products.

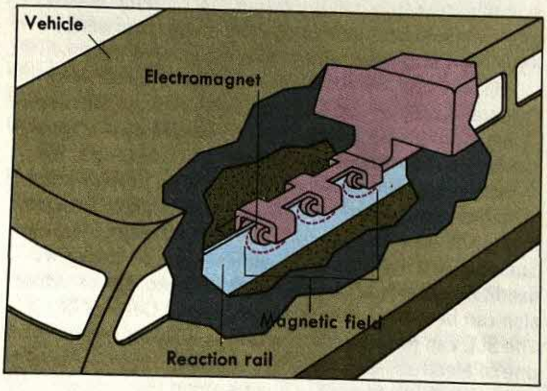
Linen has been a popular fabric for clothing. Linen feels cool because it conducts heat well and carries off the body's heat. Although linen is comfortable, it creases easily. Linen fabric can be treated with a resin to improve its crease resistance, but the fabric becomes less comfortable as a result. Linen fabric is used for tablecloths, napkins, dish towels, and handkerchiefs because it wears well and is highly absorbent.

Preparing the fibres. Flax harvested in late summer produces the finest quality linen. The stalks are pulled, tied into bundles, and dried in the sun. They then pass through a coarse comb that removes the seeds.

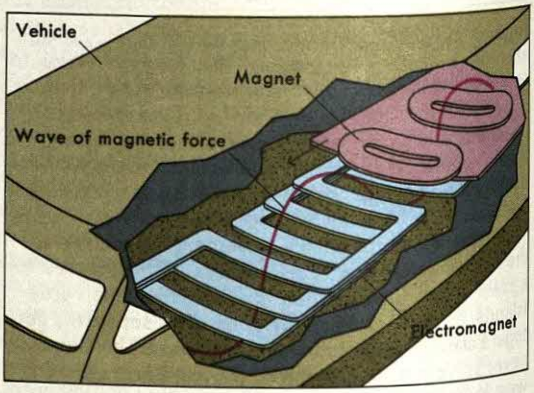
Next comes a process called *retting,* which is actually a kind of rotting. In *dew retting,* the stalks are spread on grass and kept moist for several weeks. The combined action of bacteria and moisture breaks down the tissue surrounding the flax fibres. The fibres can then be separated from the woody bark and straw of the stalk. In *water retting,* which is more common, the stalks are retted in slow-moving rivers or bogs for one or two weeks. In another method of water retting, the stems are soaked in large tanks of warm water for four to eight days. Retting with chemicals is quicker than the other methods, but the chemicals used may weaken the flax fibres.

After retting, the flax is dried. A machine then breaks the woody bark into small bits and separates out the fibres. Finally, the fibre is combed to produce long fibres called *line* and short, irregular fibres called *tow.* Line is most often woven into high-quality products such as fine tablecloths and very thin fabrics. The yarns spun from tow may be coarse and are generally used in dish cloths and other less expensive items.

History. Flax has been used as a fibre for thousands of years. A shred of cloth apparently made from flax, discovered at Cayonu, southeastern Turkey, is estimated to be 10,000 years old. The ancient Egyptians grew flax along the Nile River about 7,000 years ago. They wrapped mummies in linen before placing them in tombs. Egyptian and Israelite priests wore linen cloth at religious ceremonies. The ancient Greeks wore linen clothing, and the Romans knew how to make linen paper as well as linen cloth. Linen fabrics were fashionable among the nobility during the Middle Ages.



A linear induction motor has a row of electromagnets that face a strip of nonmagnetic metal, called a *reaction rail.* The electromagnets create a moving magnetic field that produces another magnetic field in the reaction rail. One magnetic field pushes against the other and thus moves the vehicle along.



A linear synchronous motor has an electromagnet mounted beneath the track of the vehicle. The vehicle itself also carries strong magnets. The electromagnet creates a moving wave of magnetic force that pushes against the vehicle's magnets and moves the vehicle just as an ocean wave propels a surfboard.

During the 1600's, skilled Flemish and French workers helped develop linen spinning and weaving in northern Europe. Since that time, linen fabrics from France, Belgium, and Ireland have become internationally famous.

In the second half of the 1700's, several machines invented in England revolutionized the linen industry. In 1787, John Kendrew and Thomas Porthouse laid the foundation of machine spinning of flax. They built a mill at Darlington, in the county of Durham. Today, annual world fibre production amounts to about 714,000 metric tons. Russia accounts for nearly half of the world's production of flax fibre.

See also **Flax.**

Liner. See **Ship.**

Lingonberry is a small fruit related to the cranberry. It grows wild in northern parts of the Northern Hemisphere. The lingonberry is known by many other names, including *bog cranberry, cowberry, foxberry, lingon, linberry, lingberry, lingenberry, mountain cranberry, rock cranberry,* and *partridgeberry.*

The fruit of the lingonberry is glossy and bright red. Raw lingonberries taste bitter, so the fruit usually is cooked for use in jam and sauces. The cooked fruit has a spicy flavour. Lingonberry jams and sauces are especially popular in the Scandinavian countries, as well as in parts of Canada and Russia.

The lingonberry is related to the cranberry.

Lingonberries grow on low evergreen shrubs. The plant's leaves are shiny and dark green on top and dark-spotted on the underside. The plant favours and grows best in a cool, mild climate. It is not widely cultivated.

Scientific classification. The lingonberry belongs to the heather family, Ericaceae. Its scientific name is *Vaccinium vitis-idaea.*

Linguistics is the scientific study of language. Linguists try to answer questions about language, such as how languages change and where words come from. Linguists study both their own languages and languages they do not speak.

When linguists study a modern language, they analyse the speech of one or more native speakers of that language. They call such a person an *informant.* Many languages have no written form. Therefore, linguists must often use a set of symbols called a *phonetic alphabet* to write down the speech sounds of an informant. Linguists also study dead languages to trace the development of modern ones.

Linguists gather data, form theories and test them, and then establish facts about language. These experts believe they know extremely little about even the most familiar languages. They hope to record and study unfamiliar tongues before such languages become extinct. There are two chief fields of linguistics, *descriptive linguistics* and *comparative linguistics.*

Descriptive linguistics

Descriptive linguistics studies the language of a single place and period. It is sometimes called *synchronic linguistics.* A linguist in this field tries to describe a language as it is acquired by the children of a community and used by the adults there. Such a study focuses on the ability of these people to speak and understand their language.

Linguists realize that people often make errors when they speak. For example, a linguist studying English might record several uses of the sentence *He did not go nowhere.* But, some speakers know they should have said *He did not go anywhere.* Linguists use the term *linguistic performance* for what people actually say.

Constructing a grammar. A descriptive linguist records the words and sentences of informants. From this record, the linguist constructs a *grammar,* a description of the ability of people to use their native language. This ability is called *linguistic competence.* The linguist often relies on the judgment of native speakers for help in constructing a grammar.

All native speakers of any language can produce and understand sentences that they have never encountered before. The number of sentences in a language is infinite, and so no language could be described by listing these sentences. Instead, the linguist devises a grammar that explains, step by step, how to construct any form of sentence in the language.

The grammar performs its function by telling how to build new sentences out of old ones. For example, the sentence *The astronomer counted the stars* could be substituted for *it* in the sentence *The queen believed it.* This substitution would produce a new, more informative sentence, *The queen believed the astronomer counted the stars.*

A grammar may be used *prescriptively* as well as descriptively. Such a grammar attempts to tell people how they should use language. For example, the grammar might suggest using the sentence *I do not have any money* instead of *I do not have no money.* However, the rules of a grammar may not reflect the language as it is actually spoken. In addition, people often express their meaning well even if they follow different rules.

The components of a grammar. The grammar of a language has three components: (1) the phonological component, (2) the semantic component, and (3) the syntactic component.

The phonological component consists of rules that tell how to pronounce words and sentences. The *phonology* (sound system) of one language may differ greatly from that of another. For example, Spanish phonology does not distinguish the pronunciation of the two English vowels in the words *sheep* and *ship.* On the other hand, the Thai language distinguishes the sound of the *t*'s in *steam* and *team,* but English does not.

The semantic component tells what sentences mean. It tells whether one sentence means the same thing as another and whether one sentence implies another. For example, *The student managed to pass the test* implies *The student passed the test.* However, the sentence *The student tried to pass the test* does not imply *The student passed the test.*

The syntactic component shows the relationship between the meaning of a sentence and the arrangement of the words in the sentence. It may show that two or more arrangements of words have a single meaning. For example, the two sentences *The waitress gave the sandwich to the tallest girl* and *The waitress gave the tallest girl the sandwich* mean the same thing. Linguists say that such sentences *paraphrase* each other.

The syntactic component may also show that a single arrangement of words has more than one meaning. For example, the sentence *The farmer thought the chicken was too hot to eat* has two possible meanings. Either the farmer thought that his dinner was too warm, or he thought that the chicken refused to eat because of the heat. A sentence that has more than one meaning is *ambiguous.*

Comparative linguistics

Comparative linguistics is the study of language as it varies from place to place, from speaker to speaker, and from one period to another. This field is sometimes called *diachronic linguistics.*

Some comparative linguists attempt to formulate universally valid statements about language structure and language change. This area of study is called *linguistic typology.*

Comparative linguists would like to be able to state how language first developed and to describe the conditions that led to its invention. But written records are relatively recent because human beings have had systems of word writing for only about 5,000 years. People have used spoken languages far longer. As far as linguists can tell, all cultures of today have equally complex languages. For these reasons, almost nothing is known about the origin of language.

Comparative linguists use two chief procedures in their study of language. These procedures are called *internal reconstruction* and *comparative reconstruction.*

Internal reconstruction involves using one stage in the development of a language to explain certain characteristics of an earlier stage. For example, a linguist may notice that the sound of *e* in the words *keep* and *kept* varies with the number of consonants that follow the vowel. The linguist may then hypothesize that the sound of *e* in the two words had been the same in earlier English. The linguist further hypothesizes that a sound change has altered the sound of the vowel in different ways, depending on the number of consonants that follow. Such a change is called a *sound shift.* The same relationship involving the sound of *e* occurs in many other words, including *sleep* and *slept* and *deep* and *depth.*

Comparative reconstruction is a procedure in which a linguist uses several similar languages to reconstruct a hypothetical language called a *protolanguage.* The linguist assumes that the protolanguage was the ancestor of the languages from which it is reconstructed.

A linguist might note that some words which start with a certain letter in various languages start with a different letter in English. For example, the English word *father* begins with an *f.* The Greek and Latin words for *father—patēr* and *pater—*begin with a *p.* Likewise, the English word *thaw* begins with *th,* and the Greek and Latin versions of the word—*tekein* and *tabere—*begin with *t.* Similarly, the English word *hide* begins with an *h.* The Greek and Latin words for *hide* begin with a *k* or *k*-like sound—*kutos* and *cutis.*

The linguist could hypothesize that Greek and Latin contain the consonants of the protolanguage. So the expert concludes that English underwent a sound shift that systematically replaced some consonants with others. This sound shift characterizes the Germanic languages, which include English, German, and Dutch.

Linguistics and other fields of study

Many linguists study aspects of language that involve other fields. For example, *anthropological linguists* study the influences that language and other elements of culture exert on one another. *Sociolinguists* try to find out how language varies with differences in age, sex, and economic and social status. *Psycholinguists* seek regularities in the ways people acquire and use language. They also study diseases and injuries that affect the ability to use language. *Mathematical linguists* are interested in the relation between human languages and the artificial languages used in computer programming. Experts in *applied linguistics* attempt to use linguistic principles to improve the teaching of reading and foreign languages.

History

Comparative and historical research. For hundreds of years, people have been curious about various aspects of language. The comparativists began their studies during the late 1700's. At that time, British politicians and merchants who had lived in India introduced Sanskrit, the ancient language of India, to European scholars. These scholars found grammatical similarities among the Sanskrit, Greek, and Latin languages. They concluded that all three languages, and perhaps others as well came from a single earlier parent language.

The term *comparative grammar* was first used by the German scholar Friedrich Schlegel in 1808. That concept stimulated modern comparative and historical linguistics. Among the first comparativists was German scholar Jakob Grimm, one of the two brothers known for their collection of fairy tales. Grimm proved that English, German, Dutch, and Scandinavian languages were not only related to each other but to Sanskrit, Greek, and Latin as well. Grimm recognized that certain consonants were regularly replaced by other consonants. This process was summarized in a relationship called Grimm's Law.

During the 1800's, linguists identified languages that belonged to a family of languages called *Indo-European—*that is, languages located primarily in India and Europe. Linguists compared archaic words of modern languages and analysed vowel changes and word endings. As a result, they established the origin of words that came from Balto-Slavic, Celtic, Germanic, Greek, Indo-Iranian, and Latin. Today, the Indo-European family has eight branches. They are Germanic, Romance, Balto-Slavic, Indo-Iranian, Greek, Celtic, Albanian, and Armenian.

During the 1800's, linguists also began a reconstruction of an earlier language known as *Proto-Indo-European* (PIE). No written record of it exists. By 1861, a German linguist named August Schleicher compiled a grammar of PIE. For many years, linguists and anthropologists have searched for the origin of Proto-Indo-European. Since 1945, their research has linked speakers of Proto-Indo-European with a prehistoric culture that developed as early as 5000 B.C. in southeastern Europe, north of the Black Sea. The culture was named *Kurgan,* meaning *barrow,* from the practice of placing mounds of dirt over individual graves.

Structuralism arose in the early 1900's. The structuralists viewed languages as systems composed of patterns of sounds and words. They studied these patterns to learn about the structure of a language. They believed each language has a distinct structure that cannot be compared with that of any other language. A Swiss linguist named Ferdinand de Saussure became the first leader of the structuralists.

The generative theory of language began during the 1950's with Noam Chomsky, an American linguist. Generative linguists believe a grammar of a language consists of certain rules for the construction of an infinite number of sentences. Generativists have shown that certain structuralist conceptions of grammar are inadequate for the description of languages.

According to generative linguists, grammatical devices called *grammatical transformations* relate sentences to one another. These transformations are necessary for a complete description of many sentences. This kind of rule had no role in structuralist theory. During the late 1970's, there was much disagreement among generative linguists as they worked to find basic and universal characteristics of languages.

Related articles in ***World Book*** include:

Anthropology (Linguistic anthropology)
Bloomfield, Leonard
Chomsky, Noam
Etymology
Grammar
Grimm
Language
Phonetics
Sapir, Edward
Semantics
Syntax

Link, Edwin Albert (1904-1981), an American inventor and businessman, developed the *mechanical trainer,* a machine on the ground that imitates aircraft flight. He built his first trainer in 1929, and received his first military order for six units in 1934. During World War II (1939-1945), thousands of Link trainers taught American aviators to fly "blind." This ground training saved millions of dollars by reducing the flying time required to train a pilot. Link's company also produced elaborate trainers used by the crews of jet aircraft. He was born at Huntington, Indiana.

Linklater, Eric (1899-1974), a Scottish born writer, achieved wide popularity as an author of amusing satirical novels. His works include *Poet's Pub* (1929), *Private Angelo* (1946), and *Laxdale Hall* (1951). Several of his novels were made into films. Linklater also wrote biographies, including *Mary, Queen of Scots* (1933), and an official war history, *The Campaign in Italy* (1951). *The Man On My Back* (1941) is his autobiography. Linklater was born at Dounby, in Orkney, Scotland, and educated at Aberdeen University. He was rector of Aberdeen University from 1945 to 1948.

Linnaea. See **Twinflower.**

Linnaeus, Carolus (1707-1778), a Swedish naturalist and botanist, established the modern scientific method of naming plants and animals. In this system, each living thing has a name with two parts. The first part of the name is for the *genus* (group). The second part is for the *species* (kind). Linnaeus' book *Species Plantarum* (1753) forms the basis for plant classification. The 10th edition of his *Systema Naturae* (1758) covers animal classification. See **Classification, Scientific.**

Carolus Linnaeus

Linnaeus was born Carl von Linné in Råshult, near Kristianstad, Sweden. His father, the parish curate, wanted him to study for the ministry. But the boy was so interested in plants that friends urged his parents to send him to medical school. While in medical school, Linnaeus supervised a small botanical garden and began an insect collection. He wrote careful descriptions of all the kinds of plants he knew, and these notes formed the basis for his books. He became famous as Carolus Linnaeus because he wrote his books in Latin.

He spent five months in 1732 collecting plants in Lapland. During this trip, he walked nearly 1,600 kilometres. Linnaeus then went to the Netherlands, where he received his medical degree. When he returned to Stockholm to practise medicine, the Swedish government gave him a position. In 1742, Linnaeus became a professor of botany at the University of Uppsala.

Linnet is a small bird in the finch family. Linnets live in Europe, northern Africa, and western Asia. They are light tan and brown with darker patches on the back and shoulders. In spring and summer, the crown and breast of male linnets turn crimson. Like other finches, linnets have a sturdy bill that is well adapted to holding and opening seeds.

These birds inhabit thickets, shrubs, and the edges of forests during the spring and summer, when they nest. They flock together in open country during the autumn and winter. Some linnets migrate to warmer regions for the winter.

Linnets build cuplike nests of stalks and grasses.

A male linnet feeds its hungry young.

They line the nests with feathers or fur. A nest usually is placed low in a shrub or tree growing in the open. Female linnets lay from 4 to 6 spotted, pale-bluish eggs. In North America, the distantly related house finch is sometimes called a linnet.

Scientific classification. The linnet belongs to the subfamily Carduelinae of the finch family, Fringillidae. It is *Carduelis cannabina.*

Linoleum is a smooth-surfaced floor covering made from linseed oil. It was the first smooth-surfaced floor covering to be manufactured on a large scale. Today, several kinds of flooring are made, and these new synthetic materials have replaced linoleum for most purposes. Such products are durable and easy to wash.

How linoleum is made. A linoleum manufacturer first mixes purified linseed oil and oxygen in a tank. This process of *oxidation* changes the oil into a rubbery substance. Heat and certain gums are added to strengthen the mixture. The resulting *linoleum cement* is then stored for several days to give it even greater toughness. After the cement has reached the desired strength, it is put into a mixer. There, pigments and such filler materials as ground cork and wood flour are added.

A machine *calenders* (presses) the substance until it is glossy, and applies it to a *backing sheet* of burlap or felt. The backed linoleum is then dried and hardened in an oven. After this *stoving* process, the product gets a coating of lacquer or wax.

Kinds of linoleum. There are two basic kinds of linoleum: (1) moulded inlaid linoleum, made in designs of two or more colours; and (2) plain linoleum, made only in single colours.

Moulded inlaid linoleum in elaborate designs accounts for most linoleum used today. A machine puts ingredients of different colours through a series of stencils onto a backing sheet. The colours are pressed onto the backing sheet. The material is then ready for stoving.

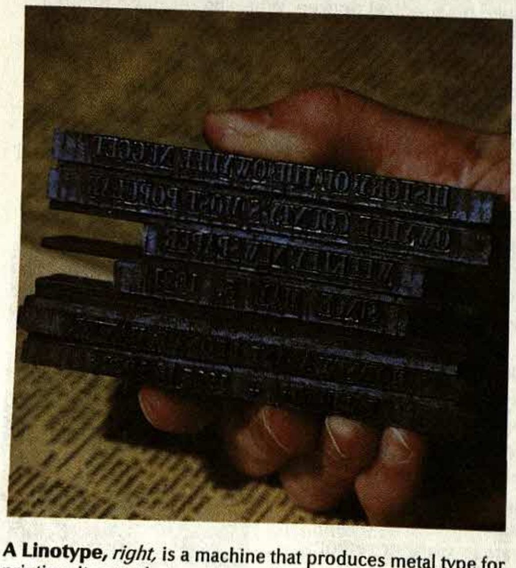
Plain linoleum. Manufacturers make linoleum of a single colour by adding a colouring pigment along with the filler. Plain linoleum is called *battleship linoleum* because it was once used extensively in warships. Today, it is used for linoleum-block printing (see **Block printing**). It may be black, brown, grey, or green.

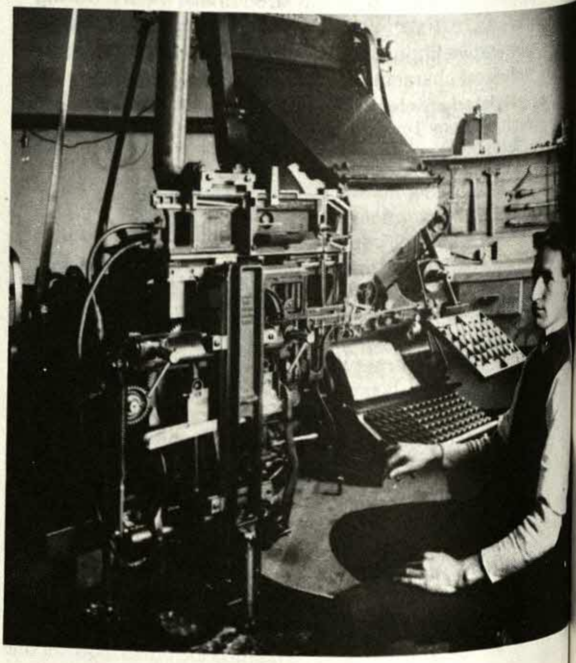
Linoleum-block printing. See **Block printing.**

Linotype is the brand name of a machine used to produce metal type for printing. It is the best-known brand of *linecaster,* a machine that forms a complete line of type at one time. Linotype typesetters were once used in the publication of nearly all newspapers and other printed material. However, *photocomposition* has almost entirely replaced the Linotype. Photocomposition is a form of typesetting that involves the production of images of type characters on photosensitive film or paper (see **Printing** [Typesetting]).

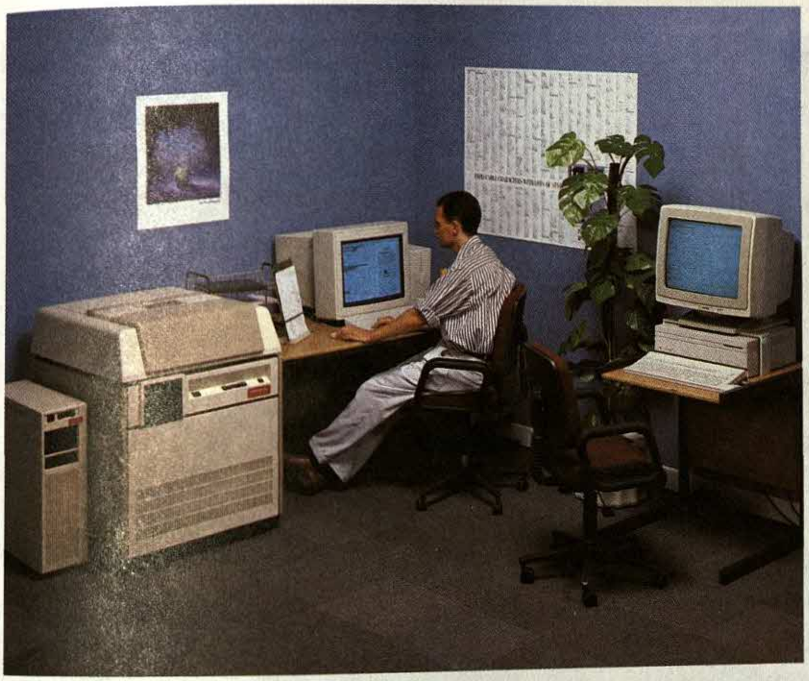
How the linotype works. The Linotype is operated by one person seated at a keyboard. Above the keyboard is a slotted metal tray called a *magazine.* The magazine holds hundreds of tiny brass moulds that are in the shape of letters. These moulds, which are called *mats* or *matrices,* fit into the slots of the magazine that correspond to keys on the keyboard. When the operator presses a letter key, the magazine releases the corresponding matrix, which drops into place in a line. At the end of each word, the operator presses another key to insert a *space band,* an expandable metal wedge. After reaching the end of the line, the operator *justifies* the line. Justification involves extending the line to fill its intended length and driving the space bands between the words to create equal amounts of space between them.

When the line is completed, the operator presses a key to send the line to be cast. Molten metal, usually lead, is forced into the matrices. As the metal cools, it hardens into a line of type with raised letters. This *slug* then drops into a tray called a *galley,* while the empty matrices are carried back up to the magazine by a mechanical arm. The matrices are automatically sorted and





A Linotype, *right,* is a machine that produces metal type for printing. It casts the type in one-line units called *slugs, above.* Since the mid-1900's, the Linotype has been gradually replaced by photographic methods of typesetting.



The Linotype sets type as metal characters, but today's typesetting machines set type as photographic images. The Linotron *(two units on the left)* converts computer-generated images of type into optical images, a line at a time, and processes them photographically.

returned to their slots to be used again. After printing, the slugs are melted down and the metal reused.

History. Ottmar Mergenthaler, a German-born inventor, demonstrated and patented the Linotype in the United States in 1884. The *New York Tribune* gave the Linotype its first major commercial use in 1886. In 1890, Mergenthaler introduced an improved machine, called the Simplex Linotype, which became a worldwide success. Before Mergenthaler's invention, galleys were assembled and taken apart by hand, one letter at a time.

Linotype typesetters were used in nearly all typesetting work until the 1960's, when photocomposition began to replace metal composition. However, in many parts of Africa, Asia, and South America, Linotype typesetters still are commonly used.

See also **Mergenthaler, Ottmar; Monotype; Printing; Teletypesetter.**

Linseed oil is an oil derived from the seeds of the flax plant. It is a type of *drying oil*—that is, it takes in oxygen from the air to form a tough film that resists breaking, chipping, and changes in the weather. Linseed oil is used primarily in printing inks, paints, varnishes, linoleum, and other industrial products. In addition, it is sometimes used as a protective treatment for concrete.

Flax seeds are made up of about 40 per cent oil and 60 per cent water and solid material. To obtain linseed oil, workers grind the flax seeds into a meal and heat it. This meal is then either crushed by a hydraulic press or treated with chemicals called *solvents* to extract the oil. The oil is refined to remove impurities. Freshly extracted linseed oil is dark brown, but the refined product is light yellow. The remaining meal, which is high in protein, is used as feed for livestock.

Today, synthetic chemicals have replaced many of the uses of seed oil. As a result, world production of the oil is declining.

See also **Flax; Linoleum; Paint.**

Linstead, Sir Reginald Patrick (1902-1966), a British chemist, made a study of organic chemicals and synthetic dyes. During World War II, he was associated with work on radar. In 1955, he became rector of the Imperial College of Science and Technology, in London. He emphasized that science should be made more understandable to the layman and that education should be broader in scope, aiming to give students a basic knowledge of both the sciences and the arts.

Sir Patrick Linstead was born in London and was educated at the City of London School and at the Imperial College of Science and Technology. He became Firth professor of chemistry at Sheffield University in 1938 and in 1939 was appointed professor of organic chemistry at Harvard University, in the United States.

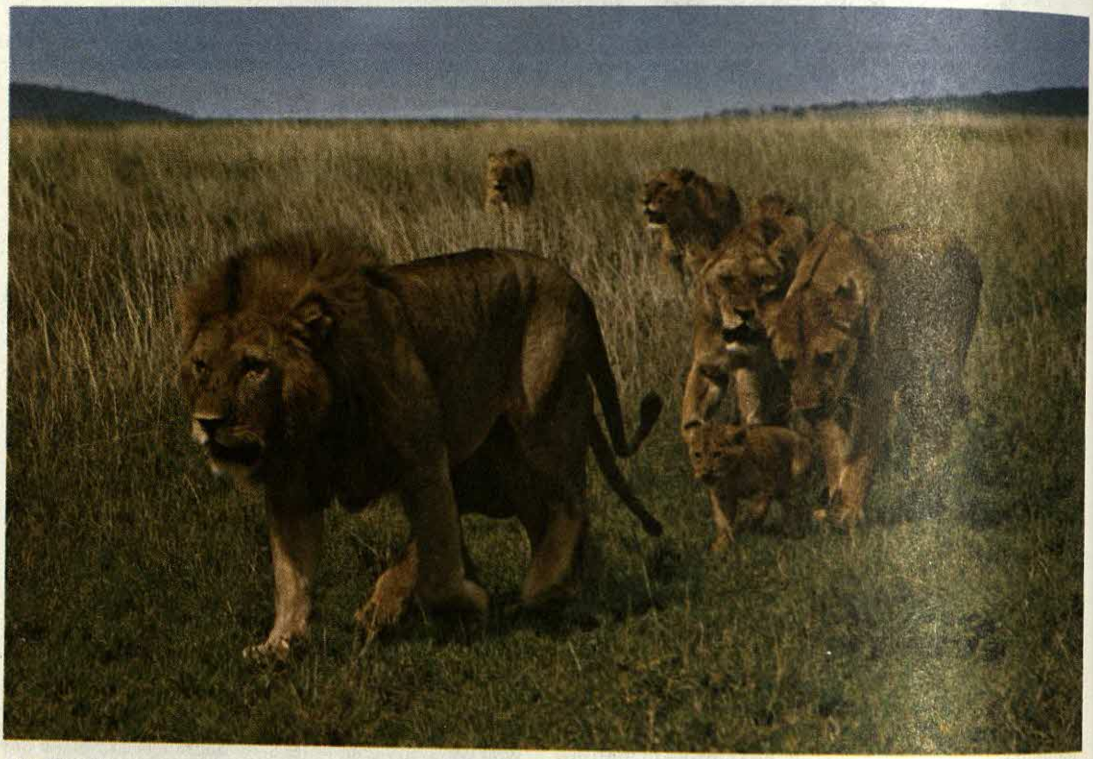
Lintel. See **Architecture** (table: Architectural terms [Post and lintel]).

Linton, Ralph (1893-1953), was an American anthropologist. He developed the concepts of *status* and *role,* which are used by many social scientists.

According to Linton, a person's status consists of a "collection of rights and duties." Such status is either achieved by a person's own efforts, or given by society to an individual based on such traits as age, parentage, and sex. Linton believed a person's status shapes his or her role—that is, the way the person functions in society. Linton also showed how a person's role affects his or her personality. He helped develop the view that each culture produces a particular basic personality type.

Linton was born in Philadelphia. While earning a Ph.D. degree at Harvard University, he researched the archaeology of Polynesia. From 1925 to 1927, he lived in Madagascar and studied the culture there. He later taught at the University of Wisconsin and at Columbia and Yale universities. Linton's books include *The Study of Man* (1936) and *The Cultural Background of Personality* (1945).

Lion, in astrology. See **Leo.**



A pride of lions moves across an open, grassy plain in Africa.

Lion is a big, powerful cat. It is probably the most famous member of the cat family. People are frightened by the lion's thundering roar and impressed by its strength and royal appearance. The lion is called the "king of beasts," and is a well-known symbol of both beauty and power.

Lions can live in cool climates and in the intense heat of semidesert areas. They do not like to live in thick forests. Most of them live in woodlands, grassy plains, and areas with thorny scrub trees. Lions live where they find a supply of food—such as deer, antelope, zebra, and other hoofed animals—and where they have a place to drink.

In ancient times, lions lived in Europe, the Middle East, India, and much of Africa. But human beings have killed thousands of lions as people settled in new areas. As a result, there are no more lions left in the Middle East and northern Africa. Only about 200 lions still live in Asia—all in the Gir Forest in India. Lions still live in the eastern part of central Africa and in southern Africa. But most live in national parks and areas called *reserves,* where the animals are protected from hunters.

Hundreds of lions also live in captivity in zoos throughout the world. And trained lions are popular performers in circuses.

The body of a lion

The lion and tiger are the largest members of the cat family. Lions are built for strength, not speed. A male lion usually weighs from 160 to 180 kilograms, but some weigh up to 230 kilograms. Most males are about 3 metres long from the nose to the end of the tail. They are about 1 metre tall at the shoulder. *Lionesses* (females) are smaller than males. They weigh only 110 to 140 kilograms and are about 30 centimetres shorter.

Male lions are the only cats with *manes.* This collar of long, thick hair covers the head, except the face, and the neck down to the shoulders and chest. The mane makes the male look even bigger and stronger than he is. It also protects him during fights. The long, thick hair softens the blows of his foes. Young males have a little hair around their heads when they are about a year old. The mane is not fully grown until the animal is about 5 years old. Manes may be blond, brown, or black. Most are a mixture of these colours. They darken as the lion grows.

The lion's coat is ideal for hiding. It is a brownish yellow, the same colour as dead grass. Only the back of the

Facts in brief

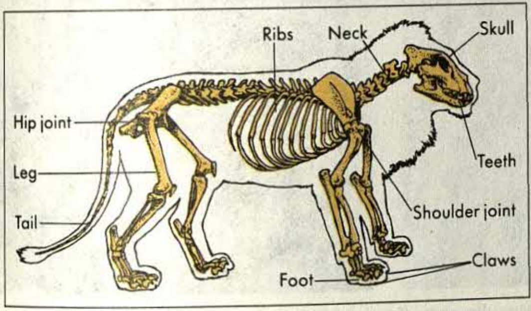
Names: *Male,* lion; *female,* lioness; *young,* cub; *group,* pride.
Gestation period: About $3\frac{1}{2}$ months.
Number in litter: 1 to 6, usually 2 or 3.
Length of life: 20 to 25 years, in captivity; in the wild, 15 to 20 years.
Where found: Africa south of the Sahara; the Gir Forest of India.
Scientific classification: The lion belongs to the class Mammalia, order Carnivora, and to the cat family, Felidae. It is *Panther leo.* The Asiatic lion is *P. l. persica.*

ears and the tuft of hair at the end of the tail are black. *Cubs* (young lions) have spots on their coats.

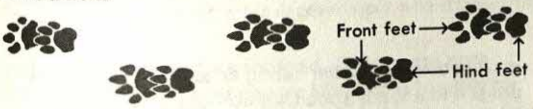
The shoulders and forelegs of the lion are tremendously muscular. They give the lion the strength to clutch its prey and pull it to the ground. Each big, heavy paw is armed with curved claws that hook and hold the prey. When not in use, each claw withdraws into a sheath in the paw so the claws stay sharp.

The lion has 30 teeth. The four large *canine* (pointed) teeth are used to hold the prey, kill it, and to tear the meat. Four cheek teeth called the *carnassial* teeth are for cutting through tough skin and the *tendons* that join muscles to bone. There are no teeth suitable for chewing. The lion swallows food in chunks.

The skeleton of a lion



Lion tracks



A lion's long, sharp teeth and huge paws are fearsome weapons. The lion can disable or kill some prey with one swipe, then use its pointed teeth to tear the prey apart.

There are several subspecies of lions. The Asiatic lion has a thicker coat and a more pronounced fringe of hair on its belly than the African lion. The tassel at the end of its tail is larger and its mane is smaller.

The life of a lion

The lion is the most companionable of all cats. A *pride* (group) may include from 10 to 20 lions, or as many as 35. Each pride has from one to five adult males, several lionesses, and cubs. The members of the pride may not always be together. Some of the lions may hunt in one place, a few in another. But when they are reunited, they greet each other by rubbing cheeks.

Life within the pride is peaceful. Lions usually spend about 20 hours a day sleeping or resting. Cubs chase each other and wrestle as they practise some of the skills they will need in their adult life. A lioness sometimes twitches her tail while one of her cubs tries to catch the tuft of hair at the end of the tail. Hungry cubs nurse on any lioness that has milk, not just their own mothers.

Lions usually walk about 8 kilometres in a day. If they have had a big meal, they may rest for 24 hours. But if they are hungry, they may travel as far as 24 kilometres in search of food.

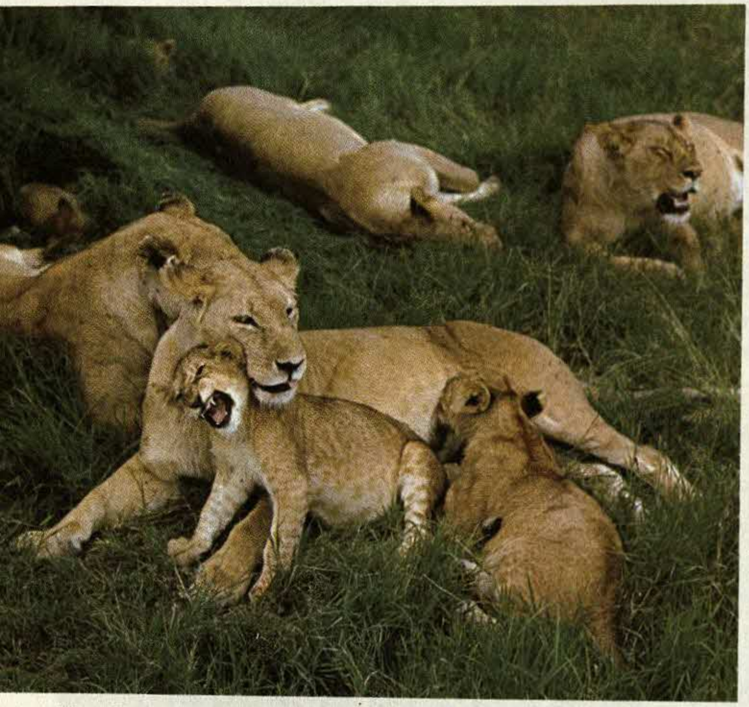
Habits. Each pride stays in a specific *territory* (area). The territory has food and water for the lions. Where prey is plentiful, the territory may cover about 40 square kilometres. Where prey is scarce, it may be 260 square kilometres.

Lions do not allow strange animals to hunt in their territory. They warn intruders to stay away by roaring or by squirting a mixture of scent and urine on bushes. The strangers then know that the territory is occupied. If they ignore the warnings, they may be killed.

Pride members stay together like a family for years, but changes occur from time to time. All male cubs are chased from the territory by their fathers when they are between 2 and 3 years old. These young males then wander until they are fully grown. Then they may challenge some pride males. If they win, they can take over the territory and the lionesses it contains. When lions take over a pride, they usually kill some of the existing cubs that have been *sired* (fathered) by the defeated dominant males. Lions in captivity die of old age at about 20 to 25 years.

Cubs. A lioness becomes an adult and mates with the pride males when she is from 3 to 4 years old. About $3\frac{1}{2}$ months later, her cubs are born in a thicket. The cubs are blind and helpless at birth, and weigh about 1.5 kilograms each. Lions do not have permanent dens. From time to time, the mother moves her cubs from one hiding place to another. She carries them in her mouth, one at a time. Hyenas, leopards, and even other lions may kill cubs while the mother is away hunting. Lions also have mated with tigers in captivity. Their offspring may be called a *tiglon,* a *tigon,* or a *liger.*

At first, the cubs live on milk. When they are about $1\frac{1}{2}$ months old, the mother leads them to an animal she has killed for their first meal of meat. The lioness usually does not have another litter until her cubs are 18 to 24 months old, old enough to hunt for themselves. Occa-



Lions like to rest in a cool, shady spot. The lionesses care for their cubs, *above.* Many male lions like to stretch out in the branches of a tree for a quiet nap, *right.* Females do most of the hunting. Males keep the pride's territory safe from intruders.

sionally, a mother abandons her cubs. When food is scarce, the mother eats and lets the cubs starve. About half the cubs survive.

How a lion hunts

Lions have to kill to live. They prefer large prey—zebra, various kinds of antelope, buffalo, and warthog. But they will also eat fish, turtles, guinea fowl—anything they can catch. They eat animals that have died from disease, and even take prey from the cheetah.

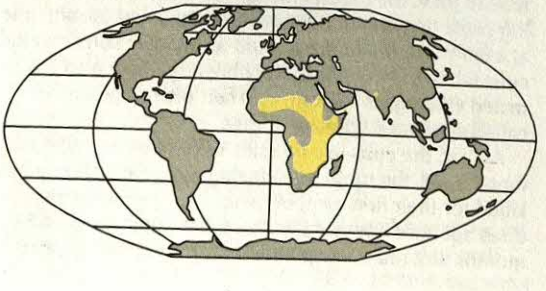
The lion lives a life of feast or famine. It may not be able to catch an animal for perhaps a week. But it usually catches something to eat every three or four days. Then the lion stuffs itself. A male lion can eat 35 kilograms of meat in one meal. After killing an animal, the lion often drags it to a shady spot. One lion can drag a 270-kilogram zebra, something that six people would find difficult to do. All members of the pride eat together, with much growling and snarling as each animal tries to get the "lion's share" of the meat.

Catching a large animal is not easy for the lion. Most of the animals it likes to eat can run faster than the lion, which has a top speed of about 55 kilometres per hour. The lion must surprise its prey by stalking. Moving slowly, its body close to the ground, the lion creeps closer. When it is about 15 metres away, it rushes forward, grabs the rump, side, or head of the animal, and pulls it to the ground. Then it usually seizes the prey's throat in its mouth and strangles it.

Lions often hunt at night because they can surprise their prey more easily in the dark. Nature has equipped the lion well for this task. Its gold-coloured eyes can see in the dark, and the lion has excellent senses of hearing and smell. Sometimes several lions hunt together. While several hide, others circle the prey and chase it toward the waiting lions that are crouched in the high grass. The male lions in the pride ordinarily let the lionesses do the hunting. But they kill for themselves when they find prey. Cubs learn to hunt by watching the adults.

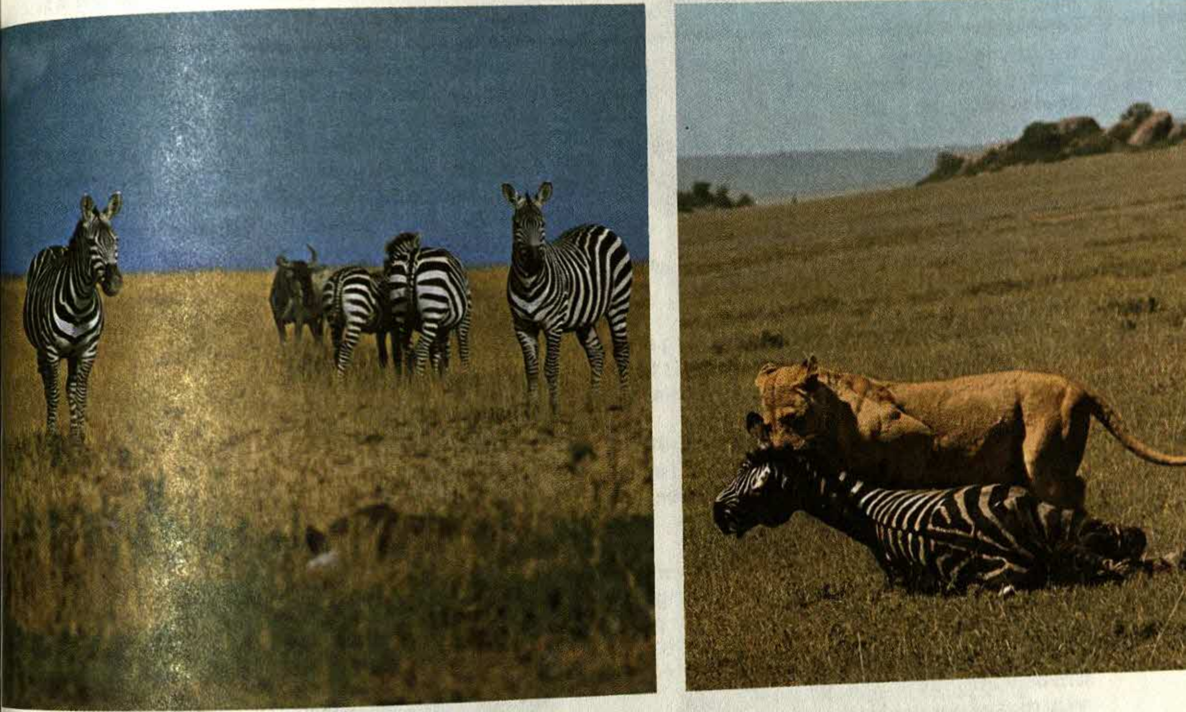
Where lions live

The yellow areas in the map, *below,* show the parts of the world in which lions are found. Most lions live in the African plains.



Lions and people

Hunting lions. Whenever lions and people come into contact, the lion always loses. People have killed the lions in most of Asia and much of Africa. Lions kill cows,



A lioness stalks her prey. Partially hidden in tall grass, *centre foreground,* she creeps close to a herd of zebras. Then she suddenly leaps out, pulls her prey to the ground, and kills it. After making the kill, she drags the dead zebra to cover, *right,* where the whole pride will feast on it.

goats, and other livestock for food. And on rare occasions they kill people. So people killed lions to protect themselves and their property.

For centuries people have also hunted lions as a way of showing courage. In about 1375 B.C., the Egyptian *pharaoh* (ruler) Amenhotep III hunted lions with bow and arrow from a chariot. He killed 102 in this manner. During the Seventh Crusade, Saint Louis and his followers chased lions on horseback and shot them with crossbows. Until recent times, the warriors of the Masai tribe in East Africa hunted lions on foot.

The Asiatic lion is an endangered species. The only Asiatic lions that remain in their natural habitat live in India's Gir Forest sanctuary. But the people who live there have destroyed much of the lions' habitat by cutting down trees for fuel and timber. Deer and other natural prey are scarce in many areas, and so the lions have killed domestic animals, such as cattle, for food. This has made the lions unpopular with farmers in the area.

African lions have a much better chance for survival. Africa has many reserves where lions may not be shot. Hunters are still allowed to kill lions in certain areas, but they must have a special license. Most people would rather photograph lions than shoot them now.

The lion tries to avoid contacts with people. It rarely attacks people unless it is tormented or injured. For example, a person can be within 12 metres of lions in the Gir Forest without danger. People there seldom harm the lions. But when provoked, and particularly when wounded, the lion is a terrible foe.

Training lions. Lions have been kept in captivity for centuries. Pharaoh Ramses II took a tame lion into battle as a mascot. The Roman Elagabalus rode in a chariot that was pulled by lions.

Trained lions have always been a favourite attraction in circuses and *menageries* (collections of wild animals). Lions can be trained to do tricks. The fact that lions look ferocious makes them spectacular show animals.

Training usually begins when a lion is about 2 years old. As long as the trainer is not careless, does not treat the lion cruelly, and remembers it is never completely tame, the trainer is safe. But lions always are liable to attack, and have mauled and even killed trainers.

In the past, lions were frequently caught in the wild and taken to zoos and circuses. They were trapped in nets or in pits dug in the ground. Sometimes cubs were taken from their mothers. Now, enough lions are born in captivity to fill zoo and circus needs. Some lionesses in zoos have as many as three litters in one year.

Lion cubs can be tamed easily. While they are small, they make delightful pets. Once they grow up, they are so big, strong, and potentially dangerous that they cannot be kept in the home.

See also **Animal** (Animals of the grasslands [picture]).

Lions Clubs, International Association of, usually called Lions Clubs International, ranks as the world's largest service club organization. It has over 37,000 clubs and more than 1.35 million club members in about 150 countries and territories. Lions Clubs are associations of business and professional men and women who

Lions Clubs emblem

seek to recognize and meet the needs of their communities. Club activities include sight conservation and work for the blind; hearing conservation and work for the deaf; citizenship, educational, health, and social services; and work for international cooperation and understanding, including international youth camp and youth exchange programmes. Some Lions Clubs sponsor Leo Clubs for young adults. The Lions Clubs International Foundation raises funds to aid disaster victims and provides vocational training for the handicapped and the poor.

The association was founded in Chicago in 1917. It publishes *The Lion Magazine* in English and 18 other languages. The organization holds an international convention each year.

Lip. See **Mouth.**

Lip reading is the technique by which one person understands the speech of another without hearing any sound. A person does this by watching another person's mouth to see the shape it makes as each word is pronounced. Lip reading is used by people who are deaf or hard-of-hearing.

Lip reading was used in the 1500's by the earliest teachers of the deaf. In 1778, Samuel Heinicke helped establish lip reading as a part of the German system of teaching the deaf. In 1843, the American educator Horace Mann observed methods of lip reading used in Germany, and urged that these techniques be adopted in the United States.

It is not easy to become a skilled lip-reader. A deaf person must practise constantly. One of the difficulties is that the lips move rapidly, even during an ordinary conversation. It is necessary for the person talking to cooperate by keeping the head still and speaking clearly and not too quickly. Some imagination is necessary to reconstruct words that have *invisible letters*—that is, letters that do not involve a distinctive movement of the lips or tongue. Certain words, such as *nine* and *died,* cause confusion, because they appear as the same word on the lips. Other words, such as *under* and *easy,* cause trouble because they require little or no motion of the lips. If such difficulties are overcome, deaf people can communicate with others effectively and without the use of sign language.

Lipase. See **Enzyme** (picture: Enzymes); **Stomach** (The stomach's work).

Lipchitz, Jacques (1891-1973), was a Russian-born sculptor whose work represents many of the major movements in modern sculpture. He studied sculpture in Paris, and his early work shows the influence of French sculptor Auguste Rodin. Lipchitz met Pablo Picasso and, beginning in 1913, his sculpture reflects the style of cubism, with its many overlapping, interacting planes.

His forms gradually became more flexible, and he began creating what he called *transparent sculpture.* This style emphasized form distorted by movement and external and internal forces that seem to be pulling in opposite directions.

By the 1930's, Lipchitz had abandoned cubism. He turned to expressionism and surrealism, with its emphasis on the subconscious. More violent, sometimes mythological themes replaced the cubist symbols in his work.

Lipchitz was born in what is now Lithuania. He studied and worked in Paris from 1909 to 1941, then moved to the United States to escape the Nazis. He became a U.S. citizen in 1957.

Lipchitz' *Rape of Europa II* in bronze illustrates the sculptor's powerful and dramatic treatment of mythological subjects.

See also **Sculpture** (Modern international).

Lipid is one of a large group of oily or fatty substances essential for good health. Lipids, carbohydrates, and proteins are the classes of compounds in all living things. Animal fats and plant oils are lipids. So are animal sex hormones and vitamins A, D, E, and K. Egg yolks, liver, and embryos of grains and other cereals are foods rich in lipids.

Importance of lipids. Lipids are vital to animals and plants in many ways. They are a concentrated source of food energy and yield about twice as many calories as an equal weight of protein or carbohydrate. Many kinds of organisms store food in lipid form. For example, the seeds of many plants contain lipids as food reserves for their embryos. The bone marrow, tissues beneath the skin and in the intestines, and tissue surrounding body organs in animals consist mostly of stored lipids.

Certain lipids form an essential part of the membranes that enclose and protect every living cell. Similar membranes surround all bodies within the cell, so that each cell body can do its job without unwanted interference from other cell bodies. Lipids repel water, but they are valuable *solvents* (dissolving substances) for vitamins A, D, E, and K, which do not dissolve in water.

Kinds of lipids. Lipids are classified as *simple lipids* or *complex lipids,* according to their structure.

Simple lipids contain only carbon, hydrogen, and oxygen. They consist of an alcohol in combination with certain organic acids containing a variable number of carbon atoms. A molecule of *triglyceride* (fat), the most common type of simple lipid, contains one molecule of an alcohol called *glycerol* and three molecules of *fatty acid* (a kind of organic acid). Fats include butter, lard (pig fat), tallow (beef or mutton fat), blubber (whale fat), castor oil, coconut oil, and olive oil. Waxes, another common group of simple lipids, contain an alcohol molecule that is larger than the glycerol molecule. For more details, see **Fat; Oil** (Fixed oils); **Vegetable oil; Wax.**

Complex lipids have a more complicated structure than simple lipids. They include *phospholipids* (lipids that contain phosphorus), *steroids* (lipids made up of four rings of carbon atoms joined together), and other compounds such as *glycolipids* (lipids with one or more sugar molecules), *fat-soluble vitamins* (vitamins A, D, E, and K), and *terpenes* (yellow pigments like carotene).

Phospholipids are found in all bacteria, and in the cells of all plants and animals. They are most plentiful in sperm, eggs, embryos, and brain cells. A molecule of phospholipid contains a molecule of glycerol, a phosphate ion, and two molecules of fatty acid. Most phospholipids also contain a compound with nitrogen in it. Some contain *inositol,* a substance found in vitamin B complex.

Steroids make up an important part of living things. Many animal hormones, including the sex hormones and those produced by the *cortex* (outer part) of the adrenal glands, are steroids. Cholesterol, a substance found in the membranes of animal cells, is a steroid. Yeasts and other fungi and the seeds of higher plants also contain steroids.

Lipizzan. See **Horse** (Saddle horses).

Lippershey, Hans. See **Telescope.**

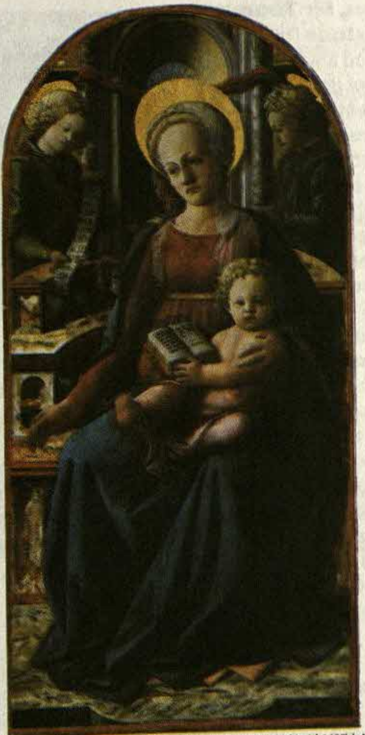
Lippi, Filippino (1457?-1504), was an important painter of the Italian Renaissance. His father and first teacher, Filippo Lippi, also was a noted painter. However, Filippino learned much of his style from Italian artist Sandro Botticelli.

Lippi was born in Prato. He achieved early success in Florence that brought him a number of major commissions. In 1488, Lippi went to Rome, where he decorated a chapel with scenes from the life of Saint Thomas Aquinas. In Rome, he developed an interest in Roman art that was reflected in his late works.

Lippi returned to Florence by 1493 and from 1500 to 1502 painted his most important late works, scenes from the lives of Saint Philip and Saint John. These paintings feature complex compositions, restless figures, and exaggerated and unusual lighting and backgrounds. Lippi's work influenced a group of Italian painters of the 1500's known as *mannerists.*

Lippi, Filippo (1406?-1469), was a leading painter of the Italian Renaissance. He painted religious subjects on altarpieces and in *frescoes* (paintings on damp plaster) in various towns in Italy. His earlier works show the influence of the Renaissance painters Masaccio and Fra Angelico in their rich colours, deep shadows, and three-dimensional figures. His later paintings are brighter and more decorative and place greater emphasis on line. His most ambitious and best-known works are a series of frescoes (1452-1464) in the Cathedral of Prato that depict scenes from the lives of Saint Stephen and Saint John the Baptist.

Lippi was born in Florence. He became a monk and is sometimes called Fra (Brother) Filippo Lippi. Lippi eloped with a nun in 1456. In about 1457, they had a son, Filippino, who also became a noted Renaissance painter. The couple were later released from their religious vows and married.



Tempera and gold painting on wood (mid-1400's); Metropolitan Museum of Art New York City

The Madonna and Child **by Fra Filippo Lippi** has a warm human quality for which the great Italian painter was famous. Lippi's son, Filippino, was also a celebrated artist.

Lippmann, Walter (1889-1974), was an American journalist who won worldwide fame as a political writer and philosopher. He became known for his clear, thoughtful writing.

In his writings, Lippmann expressed the view that civilized society could exist only if people govern their conduct by reason instead of impulse.

From 1931 to 1967, Lippmann wrote a column called "Today and Tomorrow" for the *New York Herald Tribune.* It eventually was printed in more than 200 newspapers. Lippmann won the 1962 Pulitzer Prize for international reporting and a special Pulitzer citation in 1958 for his commentary on national and international affairs.

Lippmann was born in New York City and graduated from Harvard University in 1910.

Lippold, Richard (1915-   ), is an American sculptor. He creates complicated airy suspensions that seem to capture space and rays of light in thin gold wires that are sometimes enamelled. An example of his delicate abstract and geometric work is *Variation Number 7: Full Moon.* It appears in the **Sculpture** article.

Lippold was born in Milwaukee and studied industrial design at the University of Chicago and the Art Institute of Chicago. Many of Lippold's sculptures have been created specifically for public buildings, including that of the foyer of Avery Fisher Hall in Lincoln Center in New York City.

Lipton, Sir Thomas Johnstone (1850-1931), founded a worldwide chain of grocery shops. He also controlled many meat processing plants; coffee, tea, and cocoa plantations; and food-processing factories. Lipton was born in Glasgow of Irish parents and began work as an errand boy. In 1865, he emigrated to the United States. He returned to Glasgow in 1871 and opened a grocer's shop. Lipton rapidly expanded his business into a chain of such shops, with interests in Ceylon (now Sri Lanka) and other countries.

Sir Thomas Lipton

Between 1899 and 1930, Lipton made five unsuccessful attempts to win the *America's Cup,* a yachting trophy, for Britain. On each occasion, his yacht was named *Shamrock.* Lipton was knighted in 1898 and made a baronet in 1902.

Liquefaction. See **Coal** (Coal research).

Liquefied petroleum gas. See **Gas** (Gas in the home).

Liqueur. See **Alcoholic beverage** (Liqueurs).

Liquid is one of the three states in which matter exists. The other two states are gaseous and solid. A liquid is similar to a gas because its molecules are not fixed to each other in any particular way, and a liquid can fit the shape of any container in which it is put. It is unlike a gas and similar to a solid because it has a definite volume, and its molecules are only slightly compressible. A liquid always seeks its own level. If a liquid is put in a container with several arms, it will rise to the same level in all the arms.

The surface of a liquid has a tension caused by molecular action, and acts like a skin. This is called *surface tension.* Because of surface tension, a greased needle will rest on the surface of water without sinking.

The molecules of a liquid often have a greater attraction for other substances than they have for each other. For this reason, they will rise in narrow tubes above their own level. This action is called *capillarity.* Plants draw water by capillary action.

If liquids are heated beyond a certain point, they change into gas. Water changes into steam. If liquids are cooled below a certain point, they change into solids. Water freezes into ice. Different liquids have different freezing and boiling points. Substances which are normally gases can be cooled and compressed into a liquid state. Some substances which are normally solid can be heated until they turn into a liquid. For added information on liquids, see the articles on the other two states of matter, **Gas** and **Solid,** and the article on **Water.**

Related articles in *World Book* include:

Boiling point
Capillarity
Density
Diffusion
Distillation
Freezing point
Hydraulics
Liquid air
Matter
Melting point
Molecule
Osmosis
Siphon
Solution
Surface tension
Vapour
Viscosity

Liquid air is a product made by greatly reducing the temperature of air until it turns into a fluid. Air becomes liquid at about −190° C. Liquid air is so cold that it boils when poured over ice, which is almost 200° C hotter. The liquid is bluish and looks like water. Liquid air, like the air we breathe, consists of about 78 per cent nitrogen, 21 per cent oxygen, and 1 per cent argon.

Scientists use liquid air in *cryogenics,* the study of temperatures −100° C and lower (see **Cryogenics**). Liquid air is considered a *cryogenic fluid* because of its extremely low temperature. It is a primary source of liquid forms of nitrogen, oxygen, and other gases. Scientists use liquid nitrogen in biology, chemistry, and physics research. It is also used in refrigerating and processing food. Liquid oxygen is used in compact, high-energy fuels for rocket engines that power spacecraft.

Properties. Liquid air affects different substances in a variety of ways. For example, liquid mercury becomes as hard as steel when liquid air is poured over it. A tennis ball that has been dipped in liquid air will shatter when bounced. A lead bell, which normally makes a dull sound, will temporarily produce a clear tone after being exposed to liquid air.

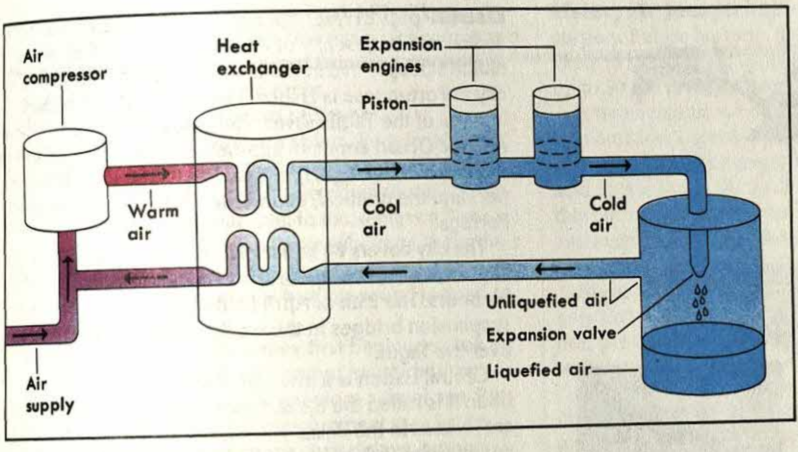
Scientists use liquid air to study the effects of extremely low temperatures on the strength of certain substances. Such materials as iron and plastics temporarily become brittle after being dipped into liquid air. However, copper and brass become tougher upon immersion in the fluid. Exposure to liquid air also makes metals better conductors of electricity and increases the strength of certain types of magnets.

Scientists measure the temperature of liquid air with special thermometers because mercury and alcohol thermometers cannot be used. Mercury and alcohol freeze at temperatures much higher than that of liquid air. The most accurate and widely used thermometer that measures the temperature of liquid air is the *platinum resistance thermometer.* It measures temperature by determining its effect on the electrical resistance of platinum. Platinum becomes a better or poorer conductor of electricity as its temperature changes. Another kind of special thermometer, the *constant-volume gas thermometer,* measures the effect of temperature on the pressure of a gas kept at a certain volume. Such gases as helium or neon are used to measure the temperature of liquid air because they turn into liquid at lower temperatures than air does.

Nitrogen and oxygen, the two major parts of air, can be separated and used in their liquid form by distilling liquid air. When liquid air is heated, the nitrogen turns into a gas before the oxygen does because the boiling point of nitrogen is lower. After the nitrogen has been removed, the remaining substance consists mostly of liquid oxygen. The high oxygen content of the undistilled liquid could cause an explosion if a flammable material came in contact with it.

Making liquid air. The process of making liquid air is based on the fact that compressed air becomes cooler when it expands. This cooling effect was described in detail in 1853 by two British physicists, James Prescott Joule and William Thomson, and it later became known as the *Joule-Thomson effect.* In 1877, Louis-Paul Cailletet, a French physicist, liquefied air for the first time.

In 1895, the German chemist Carl von Linde invented a commercial process for liquid air production based on the Joule-Thomson effect. Linde's method is still used



Most liquid air is manufactured by the Claude process. In this process, an *air compressor* increases the air pressure. The air, heated by compression, is cooled slightly in the *heat exchanger.* The air then enters *expansion engines,* which greatly reduce its temperature. Some of the air liquefies as it flows through the expansion valve.

today but with many improvements. Compressors raise the air pressure in a chamber to about 210 kilograms per square centimetre. Compression heats the air, and so water jackets on the compressor, plus a device called a *heat exchanger,* are used to lower the compressed air's temperature before it is liquefied.

Air can be liquefied in one of two ways. In one method, called *Joule-Thomson expansion,* the compressed air flows through a series of throttling valves into increasingly larger chambers. The pressure and temperature of the air decreases in each chamber as the air expands. In the final chamber, some of the air has become cold enough to condense into liquid. The cold vapour from this chamber is circulated around the other chambers to help cool the air that is still going through the liquefying process.

In 1902, Georges Claude, a French engineer, developed the second method of liquefying air. It resembles Joule-Thomson expansion but is more efficient because it makes use of work done by expanding air. In the Claude method, air enters a chamber and pushes a piston as it expands. As the piston moves, the volume of the chamber increases, which causes the chamber's air pressure and temperature to decrease. The air is sent through a series of these piston-equipped chambers, called *expansion engines,* until it becomes liquid.

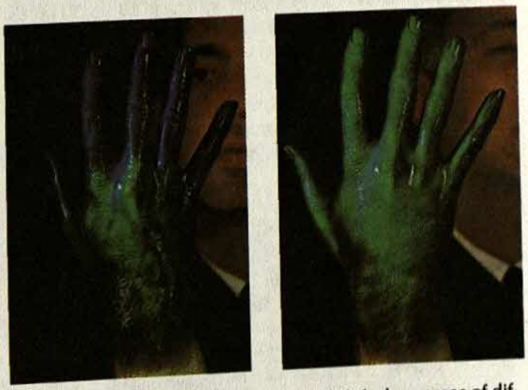
Special containers called *Dewar flasks* protect liquid air from heat and evaporation. A Dewar flask is a bottle made of two layers of glass, with space between the layers to insulate the contents. The flask may be coated with silver to reflect heat. Large quantities of liquid air for industrial use are stored in huge insulated tanks.

Liquid crystal is a substance that has the properties of both a liquid and a crystal. Like a liquid, it can flow. However, like a crystal, its molecules are partially lined up. An electric field or changes in temperature can disrupt the alignment of the molecules and make the liquid crystal become murky or change colour. This property gives liquid crystals a practical use in the displays on calculators, computers, watches, and dashboards of cars.

To create the numbers and letters that appear in the displays, small electric voltages are set up across a liquid crystal. When the voltage is turned off, the liquid crystal is clear and cannot be seen. But when the voltage is turned on, the liquid crystal becomes milky enough to be seen. Its molecules then cause some of the light that strikes the liquid crystal to scatter. In a calculator, electronic impulses control which portions of the display become milky so that those portions form the shape of a number or letter.

Certain liquid crystals can be used to measure temperature or to detect hot or cold spots on a surface. This type of liquid crystal scatters certain colours of light because of the special way its molecules line up. The temperature of the surface determines which colour is scattered.

See also **Watch** (Electronic watches).



Liquid crystals painted on a man's hand, *left,* show areas of different temperatures as different colours. Blue is the warmest area, green cooler, and red coolest. The colour change to green, *right,* indicates that the temperature of the hand has dropped.

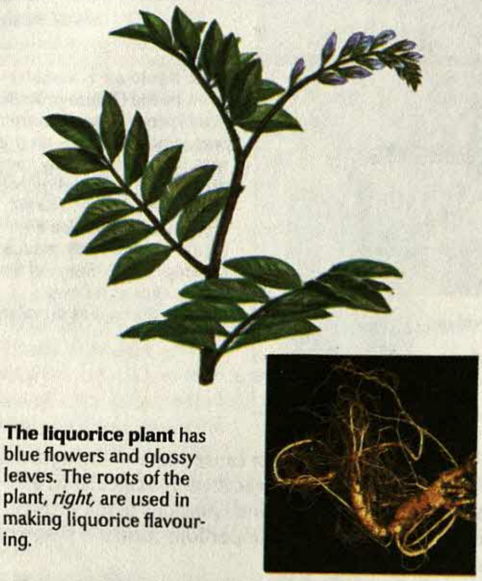
Liquid fire. See **Flame thrower.**

Liquid measure. See **Weights and measures; Barrel** (pictures).

Liquid oxygen. See **Oxygen** (Other uses).

Liquidambar is the name of four species of deciduous trees with maplelike leaves that turn bright colours in the autumn. Liquidambars are found in Asia and North America. They are grown for their red-coloured timber, as ornamental trees, and for the aromatic resin known as balsam that is used in medicines, and as a scent in soaps and related products.

Scientific classification. Liquidambars belong to the family Hamamelidaceae, genus *Liquidambar.*



The liquorice plant has blue flowers and glossy leaves. The roots of the plant, *right*, are used in making liquorice flavouring.

Liquorice is a herb that contains both a valuable flavouring and compounds of medicinal value. Its flavouring comes from the herb's long, sweet roots and *rhizomes* (root stems). The roots and rhizomes contain a compound, called *glycyrrhizin*, which is about 50 times as sweet as sugar. Liquorice is a *perennial*—that is, it lives for more than one growing season.

Liquorice is a native of southern Europe and parts of Asia. The plant grows to about 1.4 metres tall and has dark green leaves. It may be grown from seeds or from cuttings of rhizomes or *stolons* (stems that grow along the ground and take root).

Liquorice extracts are used to flavour tobaccos, cigars, cigarettes, sweets, soft drinks, and alcoholic beverages. Liquorice extract has traditionally been used to flavour medicines. The root fibres remaining after the liquorice is extracted are used in making a fire-fighting foam, insulation board, and other products.

Scientific classification. Liquorice is a member of the pea family, Leguminosae (Fabaceae). The liquorice plant most valuable commercially is *Glycyrrhiza glabra*.

Lira is a unit of money in Italy and Turkey. The word comes from the Latin term *libra*, meaning *pound*. For the value of the lira, see **Money** (table: Exchange rates).

The 100-lira Italian coin is shown above.

Lisbon (pop. 817,627; met. area pop. 2,062,200) is the capital and largest city of Portugal. About a fifth of the nation's people live in the Lisbon area. The name of the city in Portuguese is Lisboa. Lisbon lies at the *estuary* (mouth) of the Tagus River. The estuary empties into the Atlantic Ocean about 16 kilometres west of the centre of the city (see **Portugal** [political map]). Lisbon is a major port and the political, economic, and cultural centre of Portugal.

The city covers 84 square kilometres. It overlooks the Tagus estuary, one of Europe's most important natural harbours. The 25th of April Bridge, one of the longest suspension bridges in the world, extends 1,013 metres over the Tagus.

Central Lisbon is a low, flat district next to the harbour. It is called the *Baixa*. Most of Lisbon's finer shops are located in the Baixa. The rest of the city is hilly, with commercial, industrial, and residential districts.

Lisbon has many public squares, statues of national heroes, treelined avenues, and small parks. Most people live in pastel-coloured houses or blocks of flats. Many tourists visit the São Carlos Opera House and the Castle of São Jorge, once the home of Portugal's kings. Another attraction is the Tower of Belém, built in the early 1500's to honour Portuguese explorer Vasco da Gama. Lisbon has several universities, including the University of Lisbon and the Technical University. Portugal's national library is in the city.

Large shipments of Portuguese ceramics, cork, sardines, tomato paste, and wine are exported from Lisbon's harbour. One of Europe's chief shipyards is across the Tagus from Lisbon. Portugal's chief banks, insurance companies, and investment firms are in Lisbon. An international airport and major railway lines serve the city. Public transportation in Lisbon includes buses, electric trains, trams, and an underground railway system.

In ancient times, the Greeks, Carthaginians, and Romans colonized Lisbon. The Visigoths captured Lisbon from the Romans during the A.D. 400's, and north African Muslims called *Moors* seized it during the 700's. In 1147, Christian forces led by Afonso I, the first king of Portugal, retook the city from the Moors.

Lisbon became the official capital of Portugal in the late 1200's. During the 1400's and 1500's, the city served as headquarters for the explorers and adventurers who established Portugal's empire in Africa, Asia, and South America. In 1755, an earthquake destroyed about two-thirds of Lisbon and killed more than 60,000 people. The Baixa was built as part of the reconstruction of the ruined city.

During World War II (1939-1945), Lisbon became a centre of international political activity because it was a neutral city. On April 25, 1974, a military revolt in Lisbon overthrew the dictatorship that had ruled Portugal since 1926.

See also **Portugal** (pictures).

Lisburn (pop. 98,826), a local government district in Northern Ireland, lies to the south of Belfast. It is bounded by Down to the east and southeast and Craigavon to the west. Lisburn is also the name of the district's main town. Other towns are Dunmurry, Hillsborough, and Moira. Important industries include electrical engineering and the production of agricultural machinery, office equipment, and textiles. Farming is also important. The town of Lisburn lies on the River Lagan. It has a cathedral built in 1623. It also has a racecourse and two golf courses. A race circuit at Dundrod stages the Ulster Grand Prix motorcycle races.

Lismer, Arthur. See **Group of Seven.**

Lisping is a type of speech problem. People who lisp have difficulty pronouncing *sibilant* (hissing) sounds, such as *s* or *z*. They may substitute other sounds or distort these sounds. For example, in the sentence "I see my sister," a person who lisps may substitute *th* for the *s* sounds and say "I thee my thithter." Another person who lisps may distort the *s* into a whistling sound instead of the normal hiss.

Many children lisp when they first begin to speak. During normal speech development, most children master the hissing sounds long before school age. But sometimes a child's speech development may be delayed. Various things can cause such delays. Among these may be loss of hearing and defects of mouth structures, particularly the tongue, teeth, and palate. Almost all children lisp when they lose their primary front teeth (see **Teeth**). Improper speech habits of parents may also delay a child's speech development and cause learning difficulties.

When lisping results from structural problems, the structures usually must be corrected before completely normal speech can be produced. Speech-language pathologists, who are specially trained to treat speech and language disorders, teach people who lisp to speak correctly. The pathologist trains individuals to recognize their own speech errors and then to form the sounds properly.

See also **Speech therapy.**

List system. See **Proportional representation.**

Lister, Sir Joseph (1827-1912), founded antiseptic surgery. Before his time, the most trivial operation was likely to be followed by infection, and death occurred in up to 50 per cent of all surgical cases.

After Louis Pasteur discovered that bacteria caused fermentation, Lister in 1865 realized that the formation of pus was also due to germs. At first, he used carbolic acid sprays to kill germs in the air, but later he realized that germs were also carried by the surgeon's hands and instruments. He insisted on the use of antiseptics on hands, instruments, and dressings, and on the patient.

His application of antiseptics so revolutionized surgery that its whole history can be divided into two periods, pre-Listerian and post-Listerian. The use of Lister's techniques virtually eliminated post-surgical infections.

Lister was born at Upton, Essex, England, and studied medicine at University College, London. He served as professor of surgery at Glasgow University, Edinburgh University, and at King's College, London. He was also surgeon to Queen Victoria. He was made Baron Lister of Lyme Regis in 1897, thus becoming the first medical man to be elevated to the British peerage.

See also **Antiseptic; Semmelweis, Ignaz P.**

Liszt, Franz (1811-1886), was a Hungarian pianist, composer, and teacher. He wrote many works for the piano and orchestra, and was the most celebrated pianist of the 1800's. He performed an invaluable service to the world of music as the teacher and sponsor of most of the brilliant musicians of his time.

His life. Liszt was born in Raiding, Hungary. His father, a talented amateur musician, was his first piano teacher. The boy's musical talent appeared early. By the time he was 11, he had been presented in many parts of Europe as a child prodigy at the piano.

Dom Pedro IV Square, popularly known as the Rossio, is a centre of lively activity in Lisbon. A monument to Pedro IV, the first emperor of Brazil, stands in the middle of the square. The Rossio lies in an area of Lisbon called the *Bairro Alto,* which has many cafes, shops, and nightclubs.

Franz Liszt

In 1823, Liszt went to Paris, where he studied music theory and composition. The French recognized him as a brilliant performer with an almost uncanny ability to improvise on the keyboard. He had once wanted to become a priest, but instead decided to follow a career in music. He was inspired by the success of Niccolò Paganini to become as much a master of the piano as Paganini was of the violin.

Liszt quickly became a favourite of intellectual and artistic circles in France, not only because of his talent but also because of his fascinating personality. In addition, his popularity was enhanced by his generosity, his fine family background, and his ability as a writer and critic.

In the early 1830's, Liszt came to know many influential people in the artistic and literary circles of Paris. He met Niccolò Paganini, the pianist Frédéric Chopin, and the composer Hector Berlioz. He also met the Countess Marie d'Agoult, who was his mistress from 1835 until 1844. Liszt was romantically involved with many women during his life, including the writer George Sand and the Princess Carolyne von Sayn-Wittgenstein.

Liszt made triumphal tours throughout most of Europe as a concert pianist. In 1848, he retired to the German Duchy of Weimar, where he had been appointed in 1842 as court music director. In Weimar, he began his productive and successful career as a composer. He also conducted opera performances and orchestral concerts and helped to make Weimar a major centre for music. He sponsored the work of Richard Wagner and his new concept of musical theatre (see **Wagner, Richard**). While at Weimar, Liszt premiered Wagner's *Tannhäuser* and *Lohengrin.* He also produced *Benvenuto Cellini,* an opera by Hector Berlioz, as well as many other works.

While the Princess Carolyne von Sayn-Wittgenstein lived with Liszt at Weimar, she strongly influenced his career as a composer. But in 1858, Liszt resigned his post at Weimar. He went to Rome in 1861. In 1865, Liszt took the vows of the four minor orders of the Roman Catholic Church and received the title of Abbé, but he never became a priest. In his later years, Liszt divided his time between Rome, Weimar, and Budapest, and taught piano and composition. In 1886, Liszt toured Europe, attending concerts presented in honour of his 75th birthday. He died at Bayreuth.

His works. Liszt composed a great number of important works for the piano. He wrote two complete concertos for piano and orchestra and an unfinished third piano concerto. For solo piano, Liszt wrote one grand sonata, several sets of variations, and numerous shorter works, including ballads, études, rhapsodies, and waltzes. He expanded the boundaries of piano technique with broadly sweeping scales and arpeggios, rapid changes of register, unusual divisions of the beat, extremes of tempo and dynamics, and dense chordal textures.

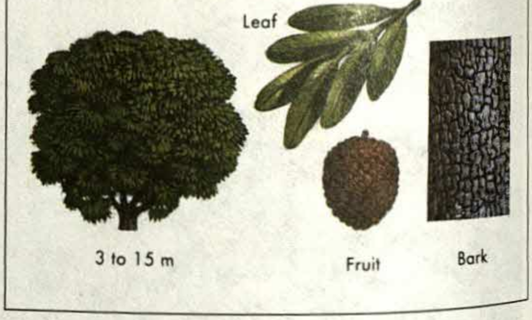
Liszt wrote two symphonies for orchestra, the *Faust Symphony* (1857) and the *Dante Symphony* (1857). He also wrote 13 symphonic poems, which he preferred to call "tone poems." *Les Préludes* (1848, revised before 1854) is the best known of his symphonic poems.

Liszt's works include a large number of choral compositions, many of them sacred works. He also wrote many songs for solo voice and piano. In addition, Liszt composed a number of pieces for organ.

Liszt transcribed many orchestral works so that they could be played by two-hand or four-hand piano. His transcriptions of Beethoven's symphonies made it possible to play and hear them in the intimacy of private homes as well as in large concert halls. Liszt also transcribed organ works by Johann Sebastian Bach and violin études by Paganini.

Litany is a form of prayer-dialogue in which the worshippers take responsive parts. The minister or priest recites a series of prayers, and the congregation gives a set response after each one. A litany may be said at any religious service as a request for grace and mercy, or for deliverance from danger, pestilence, or sin. The three litanies most commonly said in the Roman Catholic Church are the *Litany of Saints,* the *Litany of the Holy Name of Jesus,* and the *Litany of the Blessed Virgin.* The *Litany of Peace* is used in the liturgy of the Eastern Orthodox Churches. The *Great Litany* appears in Lutheran prayer books and in the Book of Common Prayer, which is used by the Anglican Communion.

Litchi is the name of an evergreen tree that bears red fruit. Its name is also spelled *leechee, liche, lichi, litchee,* and *lychee.* The litchi originated in southern China, where it has been cultivated for its fruit for more than 2,000 years. Litchis also are grown commercially in Australia, India, South Africa, and the United States.



The litchi is an evergreen tree that grows in warm climates. The tree bears clusters of bright red fruits also called litchis.

The litchi fruit is round and ranges from 1 to 3.5 centimetres in diameter. It has rough, papery red skin and juicy, white flesh with a single brown seed. The fruit is rich in vitamin C. It usually is eaten fresh but may be canned in light syrup or dried like raisins.

Litchi trees grow best in subtropical areas in deep, well-drained soil. They may grow up to 15 metres high.

Scientific classification. The litchi belongs to the soapberry family, Sapindaceae. It is *Litchi chinensis.*

Literacy. See **Illiteracy; Reading.**

Literary criticism. See **Criticism.**

Christie's, London/Bridgeman

All literature needs readers. The reader helps to create literature by responding to the ideas and thoughts of the writer. We all read for a variety of reasons, but one of the primary reasons is pleasure.

Literature

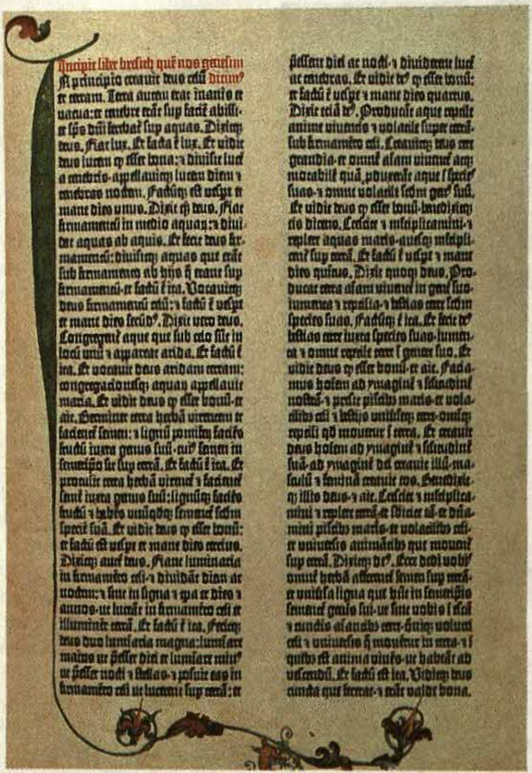
Literature in its broadest sense is anything constructed from a meaningful arrangement of words. The term for such an arrangement is *text.* Literature in this sense includes comic books, folk tales, and tourist brochures as well as novels, plays, and poetry. In a narrower sense, there can be different kinds of literature. We may speak about a literature written in a certain language, such as French literature, or a literature from a country, such as American literature. We often speak about the literature of a period, such as Renaissance literature. We may also refer to the literature of a subject, such as gardening literature, or scientific literature.

The word *literature* is used to describe works of the imagination that are either written or handed down through oral tradition. In many cultures, the greatest works are not written but are preserved in people's memories, and so we may distinguish between *written literature* and *oral literature.* Written literature includes a huge variety of texts, both fiction and non-fiction, such as poetry, plays, novels, short stories, travel accounts, diaries, autobiographies, biographies, collection of letters, essays, histories, and philosophy. Oral literature includes folk tales, epic poems, children's rhymes, riddles, prayers, and made-up stories.

Enjoying literature

Why we read literature. We all read for a variety of reasons. These reasons change with our age, our interests, and the literature we read. Our basic reason for reading is probably pleasure. We read literature mostly because we enjoy it.

Reading for pleasure may take various forms. We may read just to pass the time. Or, we may want to escape from our everyday world. Reading is like a jet aeroplane that speeds us away from our own lives into the faraway worlds of other people.



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Written literature includes a huge variety of texts, both fiction and nonfiction. Religious texts, such as the Bible, *above,* are considered among the great works of world literature.

We often read for information and knowledge. We find pleasure in learning about life in the Swiss Alps or on the Mississippi River. We find possible solutions to our problems when we meet people in books whose problems are like our own. Through literature, we sometimes understand situations we could not otherwise understand in real life.

We also read simply for the enjoyment we get from the arrangement of words. We can find pleasure even in nonsense syllables, just as children like the sound of "Ring-a-ring-a-roses," although they may not know what the words mean.

How to read creatively. All literature needs readers. The reader helps to create literature by responding to the ideas and thoughts of the writer. Octavio Paz, the Mexican writer, said that literature is like leaves on a tree; once the leaf drifts off the branch, it no longer belongs to the tree, and once a work is written, it leaves the author and becomes the property of the reader. This means that there is no right and wrong way to read literature. Tastes change, and different cultures have different ideas about what is good and bad. A work that is popular in one time may be a failure in another. The novels of the French writer Émile Zola shocked readers in the 1800's, but today they are read in schools.

Some works are considered by critics to be *classics,* or literature that survives across the ages. But even classics are read differently in different ages; the plays of William Shakespeare were disliked in the 1700's, and some were not performed at all or were rewritten or censored. Ideas about what is a classic are always changing. Today we would rank Dostoevsky's *Crime and Punishment* as a great classic, along with more recent works like *One Hundred Years of Solitude* by Gabriel García Márquez and Alice Walker's *The Color Purple,* but 50 years ago people thought classics should be old works by writers from an earlier age.

Judging literature. Every reader makes judgments about what he or she reads, and the more we read, the better equipped we are to make comparisons and to see how literature develops. For example, the horror films and horror fiction by writers such as Stephen King and Clive Barker can be traced back to the American writer Edgar Allen Poe and even earlier to the Gothic novel of the 1700's (see **Gothic novel**). Seeing how writers borrow from other writers from different cultures and different times makes us see how the world changes. Reading can put us in touch with the world we live in and with the world of our parents and ancestors.

The elements of literature

Literary works contain different components, or elements. Some of the principal elements are plot, theme, style, image, sound patterns, and characterization. Not all works have all these elements. For example, a detective novel will certainly have a plot and probably have clearly defined characters, but it will probably have no conscious sound patterns. A lyric poem, on the other hand, will have sound patterns and probably images, but it will have no plot and no characters. In the novel, the principal elements are usually (1) characters, (2) plot, (3) theme, and (4) style.

Characters. Writers may want to describe actions or ideas. But they must also describe the characters—the people or objects—affected by these actions and ideas. The characters make up the central interest of many dramas and novels, as well as biographies and autobiographies. Even a poem is usually concerned with characters. The speaker, or the poet, is often the main character of a poem. Writers must know their characters thoroughly and have a clear picture of each one's looks, speech, and thoughts.

Motivation means the reasons for a character's actions. Writers try to ensure that the motives of their characters make sense. In literature, as in life, character determines action. It would be difficult for Tom Sawyer and Oliver Twist to change places. If Tom were in Oliver's place, the novel *Oliver Twist* would turn into a different kind of book.

Setting is the place in which a character's story occurs. Literary characters, like the people who read about them, do not exist alone in space. They act and react with one another. They also respond to the world in which they live, a world imagined or described by the author. The Missouri of Tom Sawyer is very different from the London of Oliver Twist, and such differences in setting help define these two characters.

Plot tells what happens to the characters in a story. A plot is built around a series of events that take place within a definite period of time. No rules exist for the order in which the events are presented.

A unified plot has a beginning, a middle, and an end. That is, an author leads us from somewhere (a character with a problem), through somewhere (the character facing the problem), to somewhere (the character overcoming or being overcome by the problem). In literary terms, we speak of a story having an exposition, a rising action, a climax, and a denouement, or outcome. The *exposition* gives the background and situation of the story. The *rising action* builds upon the given material. It creates suspense, or a reader's desire to find out what happens next. The *climax* is the highest point of interest. The *denouement* ends the story.

Theme, or statement, is the basic idea expressed by a work of literature. It develops from the interplay of character and plot. A theme may warn the reader to lead a better life or a different kind of life. It may convey the author's moral or political beliefs.

Serious writers strive to make their work an honest expression of *sentiment,* or true emotion. They avoid *sentimentality,* which means giving too much emphasis to emotion or pretending to feel an emotion. A writer of honest emotion does not have to tell the reader what to think about a story, but allows the reader to draw his or her own conclusions.

Style is the way a writer uses words to create literature. It is one word following another, and one paragraph leading to the next. We can seldom enjoy a story's characters or plot without enjoying the author's style. The way writers write is part of what they have to say. From the first word to the last, a writer must solve problems of style by answering such questions as: "What kinds of words shall I use?" "How shall I present details?" "Should paragraphs be long or short?"

A writer's *point of view,* or the way a story is presented, is another part of style. A writer may tell a story in the first person (I) as though the narrator were a major or minor character in it. Or, the writer may use the third person (he or she) method, in which the narrator stands apart from the characters and describes the action. In the third person *limited* point of view, the narrator describes the events as a single character might see and hear them. In the third person *omniscient,* or all-knowing, point of view, the narrator reports on what several characters are thinking and feeling.

Kinds of discourse

The word *discourse* refers to *communication.* In literature, it means the way writers tell their readers what they want them to know. A writer may use four kinds of discourse: (1) exposition, (2) argument, (3) description, and (4) narration. The writer's purpose determines which kind of discourse is used.

Exposition answers a real or an imaginary question. It is the writer's way of presenting facts or of explaining what a thing means, how it works, or why it is important. *The World Book Encyclopedia* has many *expository* articles, including this one.

Argument tries to convince readers of an attitude, or to persuade them to share the writer's attitude. A writer may try to change the reader's mind by using argument that appeals to reason, to emotions, or to both.

Description is used to picture something that the writer wants the reader to see. Writers use description when they write about the appearance of a person, an apple, or a building. Through description, the writer appeals to the reader's sense of touch, taste, smell, or hearing. A writer has described skilfully when the reader senses the object described.

Narration gives an account of action or events. It tells the reader what is happening. If we think of description as a picture, narration may be considered as a moving picture.

A writer may use all four kinds of discourse in a single piece of literature. For example, "The Rime of the Ancient Mariner," by Samuel Taylor Coleridge, begins with *narration* when it tells how the Mariner stops a guest at a wedding feast:

> It is an ancient Mariner,
> And he stoppeth one of three.

The guest engages in *exposition* when he explains:

> The Bridegroom's doors are opened wide,
> And I am next of kin;
> The guests are met, the feast is set:

The Mariner makes use of *description* as he tells:

> And now came both mist and snow,
> And it grew wondrous cold:
> And ice, mast-high, came floating by,
> As green as emerald.

The author uses *argument* in the poem's last section:

> He prayeth best, who loveth best
> All things both great and small;
> For the dear God who loveth us,
> He made and loveth all.

The world of the writer

No literary work can be completely separated from the man or woman who created it. Authors must write from within their own experiences, both real and imagined. As readers, we can enlarge our literary understanding by looking into the world of the writer.

The writer's outer world. No author writes in a vacuum. The period and society in which the author lives, and the works of other writers, all influence the author.

Many of the greatest contributions to literature have resulted from an author's reaction to social conditions. For example, the writings of Martin Luther and John Calvin influenced and were influenced by the Protestant Reformation in the 1500's. Sor Juana Inés de la Cruz, the first Latin American poet, was a nun who protested against the restrictions imposed on women in Mexico during the 1600's. In some countries, writers have been imprisoned, tortured, and killed for daring to express their beliefs and speak out against oppression.

The writer's inner world. The background, interests, and physical assets and handicaps of authors also affect their writing. Likewise, the personal relationships of writers to their homes, families, friends, and enemies all become the materials of their art. For example, the French poet Christine de Pisan would probably not have become a writer, especially in the 1400's, if she had not lost her husband at an early age and chosen to write about it. The English writer Charles Lamb would probably have written differently if he had not stuttered, if he had not taken care of his sister Mary, and if he had not been a bachelor.

British Library, London/Bridgeman

The writer's world influences his or her writing. The French poet Christine de Pisan, *above,* would probably not have become a poet if she had not lost her husband at an early age, and chosen to write about her experiences.

We can follow the development of a writer as we read through his or her works. Some writers change direction, moving from poetry to prose or drama to poetry in order to explore and develop their ideas further.

The writer's attitude. We can distinguish broadly between two approaches to writing. Some writers choose to write about the world they live in, describing it in detail that enables us to recognize the reality of it. This kind of writing is called *mimetic,* because it seeks to reflect the real world. One popular type of mimetic writing is called *realism,* because it portrays the world as the writer actually sees it, with all its unpleasant aspects. Realist writers are like historians, and force us to look hard at the reality they are presenting. Alexander Solzhenitsyn's *The Gulag Archipelago* shows us graphically how terrible life in a Soviet labour camp could be.

The other approach taken by writers is one that is non-mimetic—that is, one that does not seek to represent the real world. This kind of writing has many different names. Writers of non-mimetic literature, depending on their approach, have been called gothic, romantic, symbolist, surrealist, fantastic, magical realist, expressionist, and anti-realist. Such writers are often in revolt against traditional ways of expression. They explore the human mind and the emotions and take us on amazing journeys into other worlds and other dimensions.

Forms of literature

The novel is a long work of fiction that tells about events in the lives of real or imaginary people. Most novels reflect the author's outlook on life. There are many kinds of novels, dealing with a great variety of subjects. For example, Eleanor H. Porter's sentimental novel *Pollyanna* describes the adventures of a young girl who always sees the good side of life. James Joyce's psychological novel *Finnegans Wake* explores the dream world of an Irish innkeeper.

A novel is a modern version of earlier forms of literature. Many of its features come from the *epic,* a serious narrative poem about a heroic figure (see **Epic**). Others stem from the medieval *romance,* an adventure story of kings and knights (see **Romance**). The Spanish *picaresque* story of the 1500's had an important influence on the development of the novel. The picaresque story described disconnected events in the life of a *picaro*—a clever, dishonest hero. The novel also grew out of the *character* of the 1600's, which portrayed familiar types of people. See **Novel.**

The short story is a short work of fiction that usually centres upon a single incident. Because of its shorter length, the characters and situations are fewer and less complicated than those of a novel. The short story has many qualities of the *ballad,* a story in verse form. It is also related to the *folk tale,* a story handed down by word of mouth from generation to generation. Many characteristics of the short story come from earlier literary forms that tried to teach a lesson. These forms include the *fable,* a story about animals, and the *parable,* a story with a religious lesson. See **Short story; Ballad; Fable; Parable.**

Drama is a story written to be presented by actors on a stage. It usually includes stage directions describing the appearances and actions of the characters. A drama takes the form of *dialogue,* or conversation, between two or more people. The two major forms of drama are tragedy and comedy.

A *tragedy* is a serious drama that ends in disaster. Aristotle laid down the basic principles of tragedy in his *Poetics.* He wrote that the purpose of tragedy was to make the audience feel "pity and fear" for the characters. The hero of any ancient Greek tragedy was a great person who suffered because of a *tragic flaw,* or character failing. The meaning of tragedy was later extended to include the story of any person who faces misfortune.

A *comedy* is a light, amusing drama with a happy ending. The characters in a comedy entertain rather than disturb the audience by their actions. Comedy includes many forms. *Low comedy,* or *slapstick,* uses noisy, boisterous action and ridiculous situations. *High comedy* gets its humour from clever, witty dialogue. *Satire* pokes fun at the foolish things that people say and do. A *comedy of manners* ridicules the social habits of a period. A *tragicomedy* tells about a serious situation that ends happily. A *black comedy* explores and exaggerates humorous elements in a very sombre situation, such as death or horror. See **Drama; Comedy; Satire; Tragedy.**

Poetry is the oldest form of literature. Poetry uses language in special ways, highlighting rhythm, sound, and imagery. Poems can be very short, like the Japanese *haiku,* which consists of only 17 syllables, or extremely long, like the great Greek epics, the *Iliad* and the *Odyssey,* said to be by Homer. Some poems use rhyme, and many poems have a particular metre, a regular pattern of syllables into which each line is divided (see **Metre; Rhyme; Rhythm**). *Blank verse* is poetry that has no rhyme but does have a regular metre. Poetry with no rhyme and no metrical pattern is called *free verse.* The language of poetry may be elaborate and beautiful, or it may be ordinary and everyday. The three main types of poetry are: (1) lyric, (2) narrative, and (3) dramatic.

Lyric poems are often short and emphasize thoughts and feelings. Many writers have used the lyric to write about powerful emotions such as love, grief, and pain. The elegy is a lament poem, for the dead or for something or someone lost forever. In the Middle Ages, a type of lyric poem made up of 14 lines was invented, called the *sonnet.* Chinese and Arabic lyric poetry each have a long tradition and are among the finest such poetry in the world.

Narrative poems tell a story. The epic or heroic poem tells the story of a great hero such as Roland or Beowulf or Ulysses or Aeneas. The Icelandic sagas tell how Vikings sailed around the world, while the Indian epic poem *Mahabharata,* the longest poem in world literature, tells the story of great Indian heroes and gods.

Dramatic poems tell a story through characters. Some dramatic poems have several speakers; a dramatic poem with only one speaker is called a dramatic monologue. Some dramatic poems are almost like plays, but are written to be read and not performed. *The Dynasts,* by Thomas Hardy, is a long dramatic poem about the Napoleonic Wars. Another English poet, Robert Browning, was a master of the dramatic monologue.

Nonfiction includes most of the writing we read in newspapers, magazines, and textbooks. Some nonfiction stands out as creative and imaginative literature.

The *essay* is the broadest form of nonfiction. It allows an author to record thoughts about any subject. *Informal,* or personal, essays reflect the author's personality. *Formal* essays, or articles, present their material in a more direct and impersonal way.

A *history* records the life of a people, a country, an institution, or a historic period.

A *biography* describes the life of a person. It is the most popular form of nonfiction today.

An *autobiography* is a person's own account of his or her life.

A *diary* is an autobiography written from day to day as the events in a person's life occur. See **Autobiography; Biography; Diary; Essay; History.**

History

The earliest literature may have been written by the ancient Sumerians, who lived in present-day Iraq. Scholars estimate that the Sumerians kept simple records in writing as early as 5,500 years ago. By the end of the 3000's B.C., they were writing literature.

Other early peoples of the Middle East, such as the Assyrians, Babylonians, Egyptians, and Hebrews, also produced literature. Their writings include fables, epics, histories, hymns, love songs, myths, and philosophical essays. Scholars regard the Old Testament as the outstanding work of early literature.

The ancient Chinese, Indians, and Persians created many significant works of literature. Some of their writings influenced Western literature. For example, many of Aesop's fables come from Oriental sources. For information on Oriental literatures from early times to the present, see the *Arts* sections in the articles on various countries of Asia, such as **Iran** (The arts). See also the articles on **India, Literature of, Japanese literature,** and **Sanskrit literature.**

Ancient literature. From 900 B.C. to 300 B.C., a civilization developed in ancient Greece that has seldom been equalled in history. The first major period of Greek literature, called the *Epic Age,* reached its height with the poems attributed to Homer, who probably lived during the 700's B.C. Homer's long narrative poems, the *Iliad* and the *Odyssey,* show the poet's musical style and his skill at creating characters in action. See **Iliad; Odyssey.**

Major poets of the *Lyric Age* (about 800 to 475 B.C.) included Sappho, who sang of love, and Pindar, whose *odes* (songs of praise) celebrated Greek victories.

Prose and poetic drama flourished during the *Attic Age* (about 475 B.C. to about 300 B.C.). Drama achieved greatness with the tragedies of Aeschylus, Sophocles, and Euripides, and the comedies of Aristophanes. Herodotus, called the *Father of History,* wrote about the Persian Wars. Thucydides treated history as a science in his account of the Peloponnesian War. Plato and Aristotle were perhaps the most important Greek writers in their influence on Western civilization.

Theocritus created *pastoral* poetry that pictured country life. He contributed much to the *Alexandrian Age* (about 300 B.C. to 146 B.C.). The *Greco-Roman Age* (146 B.C. to about A.D. 529) began after the Romans conquered Greece. It produced the *Lives* of Plutarch and collections of poems called the *Greek Anthologies.*

The Roman conquerors copied Greek literary styles. Plautus and Terence, the leading writers of Latin comedies, based their plays on Greek dramas. Virgil, the greatest Roman poet, modelled his national epic, the *Aeneid,* on the *Iliad* and the *Odyssey.* Horace, Virgil's younger contemporary, wrote polished formal verse of great beauty. Ovid retold many Greek myths in his *Metamorphoses,* a collection of about 250 stories.

The speeches and writings of Marcus Tullius Cicero and Julius Caesar were composed from about the 60's B.C. to the 40's B.C. These works reflect Roman civilization more clearly than do many of the plays and poems of the time. Cicero is best known for his *Philippics,* a series of speeches attacking his political enemy Mark Antony. Caesar is particularly remembered as an author for his *Commentaries on the Gallic War.* See **Greek literature; Latin literature.**

The Middle Ages lasted from about the A.D. 400's to the 1400's. After Rome fell to the Goths in the 400's, most of the Greek and Roman poems and plays were forgotten for many years. The groups that invaded the Roman Empire brought their own traditions. Epic poetry became an important form for recording legends that had been handed down by word of mouth for hundreds of years. The Anglo-Saxon epic *Beowulf* appeared about 700 (see **Beowulf**). The French *The Song of Roland* was written about 1100, and the German *Nibelungenlied (Song of the Nibelungs)* appeared about 1200 (see **Roland; Nibelungenlied**). Many Scandinavian *sagas* (long epic tales) were recorded during the 1200's (see **Saga**).

Narrative stories of adventure, fantasy, and courtly love grew in importance from the 900's to the 1200's. These *romances* reflected the systems of feudalism and chivalry that dominated Europe (see **Knights and knighthood; Romance**). The Celtic tales of King Arthur and the Knights of the Round Table became popular in Britain (See **Arthur, King**). Similar stories appeared in France, Germany, Spain, and Italy.

Lyric poetry grew in importance during the 1100's and 1200's in Europe, probably owing to the influence of the great Arabic tradition. Wandering minstrels, called *troubadours* and *trouvères* in France and *Minnesingers* in Germany, composed songs of love to entertain noblemen and their ladies (see **Troubadour; Trouvère; Minnesinger**).

In the 1300's, religious thought inspired Dante Alighieri's *Divine Comedy,* one of the great poems of all time. Dante broke away from the tradition that educated men must write only in Latin. He wrote his poem in Italian. The *Divine Comedy* is important not only for itself, but also because it was the first serious literary work written in a modern European language. See **Divine Comedy.**

The genius of Geoffrey Chaucer dominated English literature during the late 1300's. Chaucer is often called the *Father of English Poetry.* In such works as the *Canterbury Tales* he helped fix the form of the English language of today (see **Canterbury Tales**).

The Renaissance brought a rebirth of learning. It began in Italy about 1300 and spread throughout Europe in the 1400's and 1500's. Scholars rediscovered Greek and Roman classics. Philosophers became curious about the nature of human knowledge. Writers used new literary forms to express the vitality of the times.

The Italian writers Petrarch and Giovanni Boccaccio were among the first to study ancient literature. Petrarch mastered the *sonnet,* a poetic form that later became popular in all parts of Europe. Boccaccio's fame rests on his *Decameron,* a collection of a hundred short stories. In France, the new thirst for knowledge produced the *Essays* of Michel de Montaigne and the rollicking tales of François Rabelais.

The Renaissance spread northward in the 1500's, reaching Scotland first and then England, and leading to some of the best-known literature in the English language. Francis Bacon took "all knowledge" for his subjects. Christopher Marlowe expanded the use of blank verse in such plays as *The Tragical History of Doctor Faustus.* Ben Jonson wrote excellent poetry and comedies. The plays and poems of William Shakespeare and the epic and lyric poetry of John Milton represent the high point of the English Renaissance.

Spanish literature enjoyed a golden age during the 1500's and 1600's. Miguel de Cervantes Saavedra, Spain's best-known writer, employed almost every literary form. Many consider his masterpiece *Don Quixote,* written in the early 1600's, to be the world's greatest novel. In the Americas, the first great poets writing in English and Spanish were women. Anne Bradstreet lived in New England and Sor Juana Inés de la Cruz worked in Mexico.

The Age of Reason. The Greek and Roman classics gained new importance in the 1600's and 1700's. Artists, writers, and scholars modelled their works after those of the ancients. They tried to achieve the clarity, simplicity, and restraint of classical art.

The *neoclassicists,* or new classicists, rejected the authority of religious tradition that had governed society since the Middle Ages. They believed that obedience to *reason* (orderly thought) would hold society together. Such writers as Thomas Hobbes, John Locke, and Sir Isaac Newton expressed the spirit of the Age of Reason.

Bibliotheque Nationale, Paris/Bridgeman

The romances of the Middle Ages were tales of adventure, fantasy, and courtly love. Among the most popular were the Celtic tales of the Knights of the Round Table.

Biblioteca Marciana, Venice/Bridgeman

Religious thought inspired Dante Alighieri's *Divine Comedy,* one of the world's great poems. It was the first serious literary work written in a modern European language, rather than Latin.

Mary Evans Picture Library

Don Quixote tells the story of an ordinary man's desire to be heroic. Written by Spanish writer Miguel de Cervantes, *Don Quixote* is considered by many to be the world's greatest novel.

They demonstrated the importance of logical thinking, and laid the foundation for modern science.

In Europe, the great writers of the Age of Reason such as Denis Diderot, Jean-Jacques Rousseau, and Voltaire (all of whom were French) raised important questions about the rights of the individual and human freedom. Rousseau led the Age of Reason with his essays on philosophy and politics and his plays and poems. Yet Rousseau, probably more than any other writer, also came to represent the spirit of rebellion against the neoclassic world. Rousseau condemned the evils of civilization, and regarded primitive human life as superior to life in society. He also emphasized the importance of the individual.

French classical literature of the 1600's reached its supreme expression in the field of drama. Outstanding works include the tragedies of Pierre Corneille and Jean Baptiste Racine, and the comedies of Molière.

Romanticism arose as a reaction against the Age of Reason. It dominated European literature from the second half of the 1700's to the mid-1800's. It also had important echoes in the United States. The romantics praised natural human instincts and wrote about their own emotions and sentiments.

Inspired by Rousseau and other political philosophers, writers and social leaders throughout Europe took up the cause of the common people. The Scottish poet Robert Burns became one of the most popular men in Edinburgh. He was loved not only because he wrote about the common people, but because he himself came from the lower classes.

The poetry of the romantics expressed new confidence in the unity, beauty, and goodness of the universe. The lyrics of Johann Wolfgang von Goethe of Germany, Alphonse de Lamartine of France, and William Wordsworth of England sang of the wonders of nature. A dark sense of melancholy often accompanied the romantic's glorification of the world. The poems of François de Chateaubriand and of Lord Byron are filled with dissatisfaction with the real world as compared to the world of the poet's dreams.

Many prose writers also composed important works during the romantic period. The novel flourished in the early 1800's with such writers as George Sand and Victor Hugo in France and Sir Walter Scott in Scotland. The Grimm brothers of Germany collected old stories and fables, and their *Grimm's Fairy Tales* became world-famous. The American author Edgar Allan Poe wrote haunting stories of horror. See **Romanticism.**

Realism. The second half of the 1800's brought a reaction against romanticism. A new group of writers called *realists* turned against the exaggerated feelings stressed by the romantics. Truth and accuracy became the goals of the realists. The novel and the drama were their best means of expression.

The great novelists of realism include Stendhal, Honoré de Balzac, and Gustave Flaubert of France; and Ivan Turgenev, Fyodor Dostoevsky, and Leo Tolstoy of Russia. Realism was mixed with romanticism in the writings of the English author Charles Dickens. Émile Zola of France led the *naturalist* movement in literature. His writings emphasized the most sordid aspects of society. Such playwrights as Henrik Ibsen in Norway, August Strindberg in Sweden, and George Bernard Shaw in England used much the same approach. See **Naturalism.**

In the United States, Walt Whitman combined realism and romanticism in his poetry. The novels of Mark Twain, Henry James, and Stephen Crane also reflected the realistic movement. See **Realism.**

The 1900's. Fiction writers, dramatists, and poets broadened the terms *realism, naturalism, symbolism, impressionism,* and *romanticism* in the 1900's. Writers increasingly experimented with form and technique in novels, stories, plays, and poems.

During the early 1900's, literature often expressed the optimism and conservative ideals of the Victorian Age, the period from the early 1830's to 1900. Then many writers began to react against the conventions and restraints of Victorian society. The studies of the unconscious mind recorded by Austrian doctor Sigmund Freud contributed to this shift in attitude. Another reason was the destruction caused by World War I (1914-1918).

Authors of the 1920's wrote about disillusioned and rootless characters. These writers, often called the *Lost Generation,* included Ernest Hemingway and F. Scott Fitzgerald of the United States. The Great Depression of the 1930's led to literature that protested against what the authors considered unjust social conditions. In the mid-1900's, works by modern Latin American and Japanese authors first gained international acclaim.

Fiction. The early 1900's have been called the modernist period. Writers experimented in all kinds of ways with the traditional form of the novel. James Joyce's *Ulysses* and *Finnegans Wake* revolutionized the novel and paved the way for the works of other great Irish writers like Samuel Beckett and Flann O'Brien. Virginia Woolf in England and Thomas Mann in Germany inspired a generation of writers, as did Rabindranath Tagore in India and Jorge Luis Borges in Argentina. Later in the 1900's, fiction flourished in many parts of the world. Among the greatest contemporary Latin American writers are Octavio Paz, Carlos Fuentes, and Gabriel García Márquez. Patrick White, the Australian novelist, Margaret Atwood from Canada, Wole Soyinka from Nigeria, V. S. Naipaul of the West Indies, and the Indian-born novelist Salman Rushdie are writers who use the English language in new and exciting ways. The civil rights movement of the 1960's and the feminist movement of the 1970's have produced a great wave of new writers.

Drama. The Irish National Theatre, founded in 1902, produced the works of several outstanding playwrights, including Sean O'Casey, John Millington Synge, and William Butler Yeats. Irish-born George Bernard Shaw was the most important figure in English drama during the early 1900's. Luigi Pirandello was the leading Italian dramatist of the period. Ibsen, Anton Chekhov of Russia, Gerhart Hauptmann of Germany, and Czech writer Karel Čapek all influenced modern drama.

In the United States, Eugene O'Neill's experiments in drama influenced such playwrights as Maxwell Anderson, Arthur Miller, and Tennessee Williams. The French theatre enjoyed great popularity with the plays of Irish-born Samuel Beckett, Jean Giraudoux, and Jean Anouilh. British playwright Harold Pinter brought a new naturalism to modern drama. Bertolt Brecht, the German playwright, was probably the most influential of all the dramatists of the 1900's. His plays used a variety of techniques to make his audience question both the actions of his characters and the politics of the time.

Poetry. The 1900's has been a great age for poetry. The work of Walt Whitman, who rejected formal verse in favour of rhythmical free verse, had an enormous effect on poetry in the Americas, including that of William Carlos Williams and the Chilean Pablo Neruda. T. S. Eliot and Ezra Pound, both U.S. citizens living in Europe, revolutionized English poetry by introducing forms from other times and cultures. The great traumas of the 1900's—the two world wars, revolutions, and other upheavals—have inspired poetry by the Englishman Wilfred Owen, the Russians Alexander Blok and Anna Akhmatova, the Polish Czeslaw Milosz, the Peruvian César Vallejo, the Spaniard Federico García Lorca, the Portuguese Fernando Pessoa, the Italian Eugenio Montale, the Jamaican Derek Walcott, and many more.

Many modern poets write intensely personal poetry that has been called "confessional" poetry. Such writers include Robert Lowell and Sylvia Plath of the United States and Marina Tsvetayeva of Russia. Through translation, the work of many poets is becoming internationally recognized.

Related articles in ***World Book.*** See the *Arts* section of the country articles, such as **Poland** (Arts). See also the following articles.

Literatures of the world

American literature
Australia, Literature of
Chinese literature
English literature
French literature
Gaelic literature
German literature
Greek literature
Hebrew language and literature
India, Literature of
Irish literature
Italian literature
Japanese literature
Latin American literature
Latin literature
Literature for children
Russian literature
Sanskrit literature
Scandinavian literature
Spanish literature
Yiddish language and literature

Forms of literature

Allegory
Autobiography
Biography
Burlesque
Criticism
Diary
Drama
Essay
Fiction
Folklore
Legend
Novel
Parody
Poetry
Prose
Romance
Saga
Satire
Science fiction
Short story

Other related articles

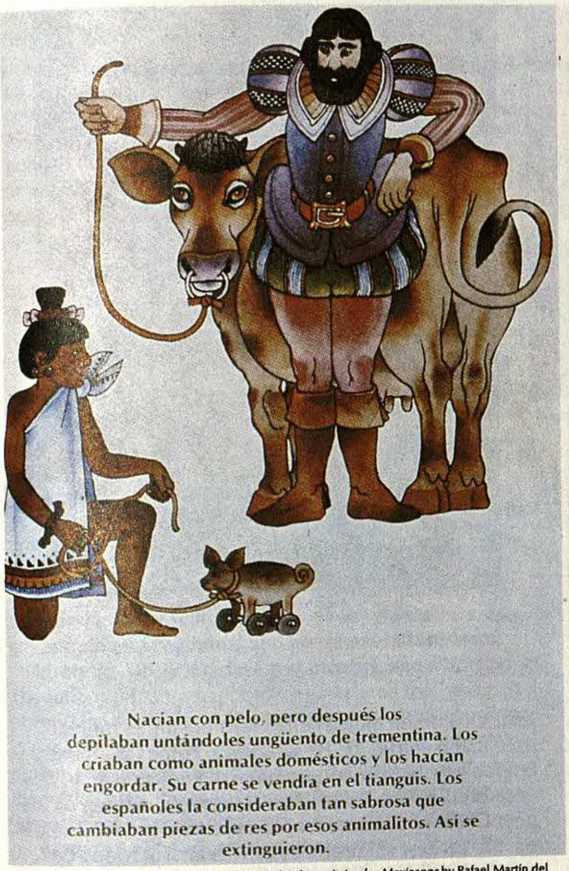
Book
Copyright
Dictionary
Encyclopedia
Language
Library
Manuscript
Mythology
Nobel Prizes
Plagiarism
Reading
Writing

Outline

- **I. Enjoying literature**
  - A. Why we read literature
  - B. How to read creatively
  - C. Judging literature
- **II. The elements of literature**
  - A. Characters
  - B. Plot
  - C. Theme
  - D. Style
- **III. Kinds of discourse**
  - A. Exposition
  - B. Argument
  - C. Description
  - D. Narration
- **IV. The world of the writer**
  - A. The writer's outer world
  - B. The writer's inner world
  - C. The writer's attitude
- **V. Forms of literature**
  - A. The novel
  - B. The short story
  - C. Drama
  - D. Poetry
  - E. Nonfiction
- **VI. History**

Questions

Do you enjoy reading literature? Why?
How does the reader help create literature?
How does environment influence a writer's work?
What are the four kinds of discourse? When is each kind used?
How did the Renaissance influence the growth of literature?
What are two differences between a romantic and a realistic writer?
How does setting influence the characters in a story?
What are the three parts of a unified plot?
What were the aims of (1) the neoclassicists? (2) the naturalists? (3) the imagists?
What are the common forms of fiction?



Nacían con pelo, pero después los depilaban untándoles ungüento de trementina. Los criaban como animales domésticos y los hacían engordar. Su carne se vendía en el tianguis. Los españoles la consideraban tan sabrosa que cambiaban piezas de res por esos animalitos. Así se extinguieron.

Illustration by Felipe Dávalos from *Animales Mexicanos* by Rafael Martín del Campo from *Colibrí,* Volume 1; edited by Dirección General de Publicaciones y Bibliotecas, Secretaría de Educacion Pública, México

Mexico

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Sweden

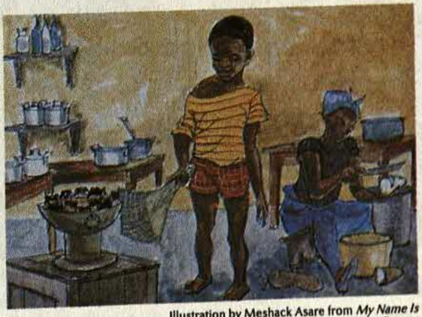


Illustration by Meshack Asare from *My Name Is Kofi,* by permission of Ghana Publishing Corp. Publishing Division, Tema, Ghana

Ghana

Literature for children opens a fascinating world of entertainment and information to young people. The books illustrated on this and the following page represent the rich variety of attractive and creative works that are available to young readers in many countries.

Literature for children

Literature for children is of two kinds: literature that has been written especially for young readers—from preschool to teenage—and literature that young readers have adopted for themselves. Well over 100,000 different books for children are produced each year for the English-speaking world alone, from picture books, poetry, and folk tales to novels and information books. The United Kingdom (UK) and the United States of America (U.S.A.) have had a great influence on children's books all over the world, but almost all countries have their own traditions, which can be very different. In India and Africa, for example, children shared spoken tales with adults. Only when the countries were colonized by Europeans were stories written down and divided between children and adults.

In Western countries, since books first appeared, children have read books intended for adults. When books were first printed there were no children's books. Children therefore adopted those books which had adventure, such as Daniel Defoe's *Robinson Crusoe,* or those which told fantastic stories, such as Jonathan Swift's *Gulliver's Travels.* As time has gone by, adults have been less inclined to read fairy stories and folk tales, and these are now usually read by children. Famous collections such as *Grimm's Fairy Tales* were first written for adults.

Pictures have been a feature of children's books since the first alphabets were illustrated with crude woodcuts in the 1600's. In the 1900's, improvements in printing have meant that the picture book has become one of the most important kinds of children's book.

Some people claim that the earliest literature written for children dates from 2100 B.C. in the form of a lullaby carved on stone tablets in Mesopotamia (now southern

Illustration by the author from *Hiroshima No Pika* by Toshi Maruki

Japan

Illustration by N. Parker from *The History of the Hoppers* by B. Parker

Australia

Illustration by Niccola Bayley from *The Mouldy* by William Mayne

England

Illustration by the author from *Man and the Horse* by Pietro Ventura

Italy

Iraq). One of the oldest collections of stories for children in the world, the *Panchatantra,* comes from India. Probably the first children's book in English was a science book called *Tretis of the Astrolabie,* written by the poet Geoffrey Chaucer for his son Lewis in 1391. In Russia, the earliest children's book was an ABC book by Ivan Fydorev, and the first Russian picture book was *The Illustrated Primer* (1694). In the 1700's, in many parts of the world, most books for children were educational or religious. In countries where Puritanism was strong, such as England and the United States, it was widely thought that it was wrong to read books just for enjoyment (see **Puritans**). However, children read the cheap books sold by *chapmen,* or pedlars, which were intended for adults, and which featured fantastic stories, such as "Jack the Giant Killer" and "Bevis of Southampton," a hero who killed a giant bull. In the United States, children's books by the English Puritans were at first imported, but were soon successfully imitated by American writers such as Cotton Mather.

In the 1800's, fun and adventure slowly crept into children's books, although girls were encouraged by their books to stay at home, while their brothers were encouraged to be more adventurous. In 1845, the German Heinrich Hoffman wrote a book of humorous "awful warnings," *Struwwelpeter,* because he could not find an entertaining book for his child. From the 1860's, books which became classics started to appear, such as Charles Kingsley's *The Water Babies* (1863), Lewis Carroll's *Alice's Adventures in Wonderland* (1864), Jules Verne's *Twenty Thousand Leagues Under the Sea* (1870), and Louisa May Alcott's *Little Women* (1868).

In the 1900's, countries as far apart as Canada and China have developed their own children's literature. In China, childhood as it is known in the West was only recognized quite recently, and in 1992 a *General Anthol-*

ogy of Modern Children's Literature in China was published in 15 volumes.

In the United Kingdom, western Europe, North America, Australia, New Zealand, Japan, and some other countries, children's literature has grown steadily. Since 1945, it has been one of the most successful areas of publishing. Almost every public library has a children's collection. Awards are given all over the world for the best books of each year. The most famous of these awards are the Carnegie Medal in the UK, and the Newbery Medal in the U.S.A. Before the Communist Party came to power in Russia, there were many magazines for children, and at the beginning of the 1900's nearly a thousand Russian books for children were being published each year. The golden age of Russian children's literature was in the 1920's and revolved around a magazine called *Novyi Robinzon* (The New Robinson). One of the most important Russian poets for children is Kornei Chukovsky.

The first section of this article deals with the various kinds of literature for children: poetry, folk literature, fiction, picture books, and information books. The second looks at the history in more detail.

Poetry. Nursery rhymes provide many children with their first contact with literature. These rhymes are usually simple and rhythmic, and are often used to teach children the alphabet, days and months, and counting. The lullaby "Hush-a-bye, baby, on the tree top" was first printed in England in 1765, but may well have its origins in ancient Egypt. Many other nursery rhymes are very old indeed. Some, like "Hey diddle diddle/The cat and the fiddle" seem to be purely nonsense. Others, like "Who Killed Cock Robin," and "Ring-a-ring o' roses" might refer to historical or political events. One of the most famous, "Higglety, pigglety, pop!" was made up by an American writer, Samuel Goodrich, in 1846. He wrote it because he strongly disapproved of nursery rhymes, and wanted to show how silly they were. See **Mother Goose** and **Nursery rhyme.**

The most famous modern collections of rhymes are *The Mother Goose Treasury* (1966), illustrated by Raymond Briggs, *The Mother Goose Book* (1976), illustrated by Alice and Martin Provensen, and Quentin Blake's *Nursery Rhyme Book* (1983).

When children grow out of nursery rhymes, they find that much of the verse written specifically for them is of the same kind—humorous or nonsense verse. The most famous writer of nonsense verse was probably Edward Lear. His first book of limericks, *A Book of Nonsense,* was written in 1846 for a family of children he was tutoring. Lewis Carroll included many nonsense verses in his "Alice" books, but several of these poked fun at more serious verses. "Twinkle, twinkle little bat," for example, mimics "Twinkle, twinkle little star," which was written by Jane Taylor in 1806.

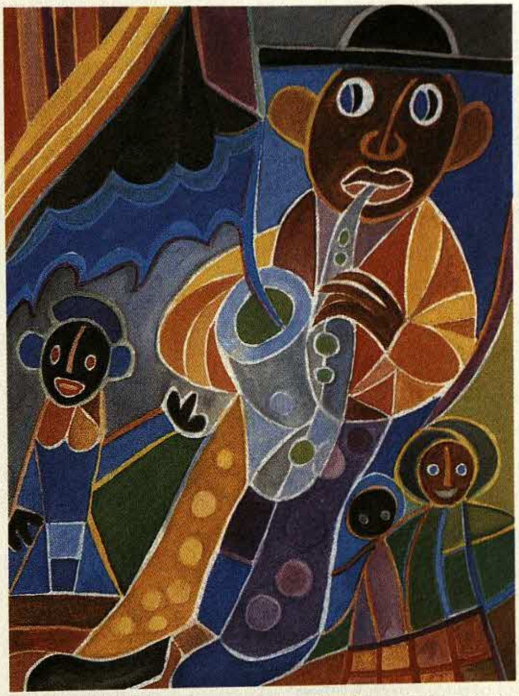


Illustration from *Sing to the Sun* © 1992, by Ashley Bryan. Reprinted by permission of HarperCollins Publishers.

A collection of poems called *Sing to the Sun* vividly portrays African American and Caribbean Island life with colourful and playful illustrations and simple but musical language.

At the beginning of the 1900's, when adults in the West saw children in a sentimental light, many rather sentimental poems were written. These followed the example set by Robert Louis Stevenson, whose *A Child's Garden of Verses* appeared in 1885. Other examples include Rose Fyleman's "There are fairies at the bottom of my garden" and A. A. Milne's "Christopher Robin is saying his prayers." The most famous of A. A. Milne's poems can be found in his collections, *When We Were Very Young* (1924) and *Now We Are Six* (1927), the most successful children's poetry books ever written.

In the 1980's and 1990's, comic verse became more related to children's real life experiences. Good examples are *A New Kid on the Block* (1984) by Jack Prelutsky, *Revolting Rhymes* (1982) by Roald Dahl, and many books by Michael Rosen, Roger McGough, Shel Silverstein, N. M. Bodecker, and David McCord. The most notable American writers of poetry for children in this period were Myra Cohn Livingston and Eve Merriam.

Poets have also written serious poetry for children, although it is often very difficult to decide what is for children and what is for adults. Writers such as Ted Hughes, Charles Causley, and John Ciardi have explored themes as important as the meaning of life in poems supposedly written for children. James Berry, John Agard, and Grace Nichols have introduced Caribbean rhymes to the UK. One of the first books of poetry about black children in the U.S.A. was written by Gwendolyn Brooks in *Bronzeville Boys and Girls* (1956). Other notable black writers are Nikki Giovanni and Arnold Adoff.

Folk literature. Folk tales, fairy tales, myths, epics, ballads, and fables are often read by, or told to, children. These stories were passed down by word of mouth from prehistoric times and were some of the first books to be printed in the 1400's. Children were among the first audiences for the stories, but childhood was very different then. Many of the tales contain material that is violent and frightening, and are about life and death, fear, sexuality, and coping with a hostile world. The same basic stories can be found in countries all over the

Illustration by Ed Young from *Lon Po Po, A Red Riding Hood Story from China*

Fairy tales have entertained children of different cultures for hundreds of years. *Lon Po Po* is a modern retelling of the Chinese version of the "Little Red Riding Hood" fairy tale.

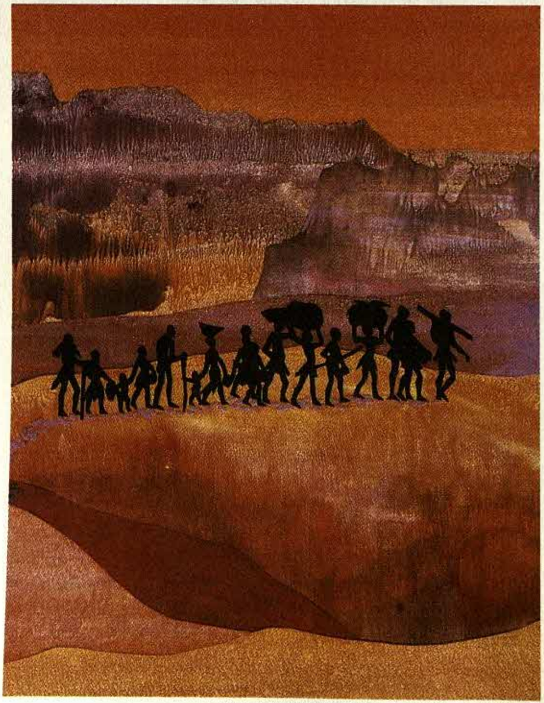


Illustration by Marcia Brown used with the permission of Charles Scribner's Sons. Illustration © 1982 Marcia Brown

Shadow is a West African folk tale about a spirit. The tale was adapted and retold by the French poet Blaise Cendrars.

world. For example, black slaves in the U.S.A. brought stories from Africa. These became widely known through the "Uncle Remus" stories. Africa is where Brer Rabbit and the stories of Anansi the spider come from. Many collections of African tales have been published in the West, including the Nigerian collection *How the Leopard Got his Claws* (1972), by Chinua Achebe. Since the mid-1800's, stories like these have been adapted for children, usually by reducing the unpleasantness and providing happy endings. In the 1900's many collections of Indian folk tales and legends were published. Collections in English include Mulk Raj Anand's *Indian Fairy Tales* (1946) and Ruskin Bond's *Tales and Legends of India* (1987). Folk tales from Indonesia and other Asian countries have appeared in a multivolume collection, *Tales from Asia,* which began to be published in 1975.

Folk tales and fairy tales are sometimes difficult to tell apart. Folk tales often deal with legendary heroes, such as Robin Hood, and also bring in elements of superstition and magic. Fairy tales are often peopled with characters such as wicked stepmothers, princes and princesses, fairy godmothers, witches, and talking animals. Tales of this kind were taken up by the aristocracy, especially in France in the late 1700's, and were rewritten by writers such as Charles Perrault. His *Tales of Past Times Told By Mother Goose,* known simply as *Tales of Mother Goose,* was translated into English in 1729. This collection included the well-known "Red Riding Hood" and "Puss in Boots." In 1812, the brothers Jacob and Wilhelm Grimm published *Household Tales,* a collection of stories that they had gathered in Germany, which are now mostly known as *Grimm's Fairy Tales.* They include "Snow White" and "Hansel and Gretel." The brothers Grimm probably changed the original stories a great deal, so as not to shock their readers. English folk tales, such as "The Three Bears" and "The Three Little Pigs", were adapted for children by Joseph Jacobs. *Arabian Nights* was first published in English in 1706, but it was nearly a hundred years later before a version for children appeared. The tale of Queen Scheherazade, who tells the sultan a story every night so that he will not kill her, comes from Syria and other countries. Scheherazade's stories include the tales of Sinbad, Aladdin, and Ali Baba. Other writers, such as Hans Christian Andersen in Denmark, and Zachris Topelius in Finland, created new "fairy" stories.

Myths, legends, and epics. Myths are stories that ancient or primitive peoples used to explain the beginning of the world, the weather, or other natural forces. Out of them developed long, "epic" stories and legends of gods and heroes. They still have strong appeal, because the stories are simple, colourful, and highly exaggerated. The most famous are the Greek stories attributed to the poet Homer. *The Iliad* tells of the war between Greece and Troy, and *The Odyssey* relates the story of the Greek hero Odysseus (known as Ulysses in Latin) and his journey home after the war. In the 1800's, the American author Nathaniel Hawthorne wrote a version of these myths for children, *A Wonder-Book for Boys and Girls.* The British author Charles Kingsley disliked the book so much that he wrote his own version, *The Heroes.* A famous modern version, *The God Beneath the Sea* (1970), was written by Edward Blishen and Leon Garfield. Legends can also spring from folk tales, such as

"Robin Hood" in England, "William Tell" in Switzerland, and the American "Davy Crockett."

In Australia, Patricia Wrightson wrote several novels that use and invent Australian folklore, notably *The Ice Is Coming* (1977). In New Zealand, many early books for children used the theme of friendship between the settlers and the Maori people.

The most influential English epic has been the legend of King Arthur and the Knights of the Round Table. The stories of King Arthur, Queen Guinevere, Merlin the magician, the magic sword *Excalibur,* Sir Lancelot, Sir Galahad, and the quest for the Holy Grail all originated in the 700's in Wales, and have been retold many times since. The first version for children was published in 1862. The story of "The Sword in the Stone," taken from T. H. White's version of the Arthurian legend *The Once and Future King* (1958), has been very popular with children.

Some legends originated in the late 1800's, especially in the U.S.A., where the cheap "dime novels" made heroes out of Casey Jones, Buffalo Bill, and even outlaws like Billy the Kid.

Ballads tell the same kind of stories in verse, and were first performed by wandering minstrels. Spain has a strong tradition of such ballads. In England, Robin Hood, who may have been a real outlaw in the 1200's, became famous through ballads. One of the few writers to write ballads today is Charles Causley.

Fables are another very ancient form of oral tale that have survived in children's books. A fable is a short story that usually gives a moral, or makes a comment on how people behave. The most well-known fables are those attributed to a Greek slave named Aesop who lived in about 600 B.C. "The Fox and the Grapes" is a well-known example. The stories of "Brer Rabbit" are another form of fable, originating in Africa. In France the most famous fables are those by Jean de la Fontaine.

Fiction. Children's books are rather more likely to deal with fantasy—things that could never possibly happen—than adult's books. This may be because young children do not always understand where real life ends and fantasy begins, while older children are happy to let their imaginations fly. Fantasy for children was frowned upon by adults in the 1700's and early 1800's, but gradually, especially in books for girls, and especially in England, fantasies became accepted. Books by Mrs. Molesworth, Lewis Carroll, George MacDonald, and Charles Kingsley set the fashion. A great favourite is a Swedish classic written in 1906-1907 by Selma Lagerlöff, *The Wonderful Adventures of Nils.*

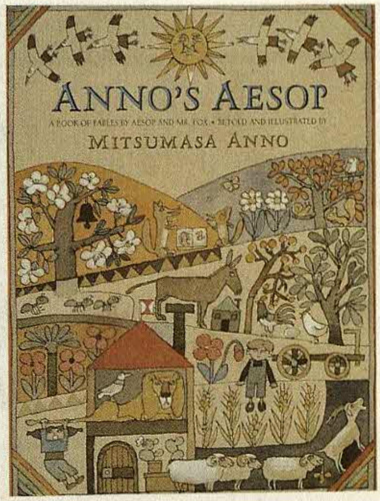
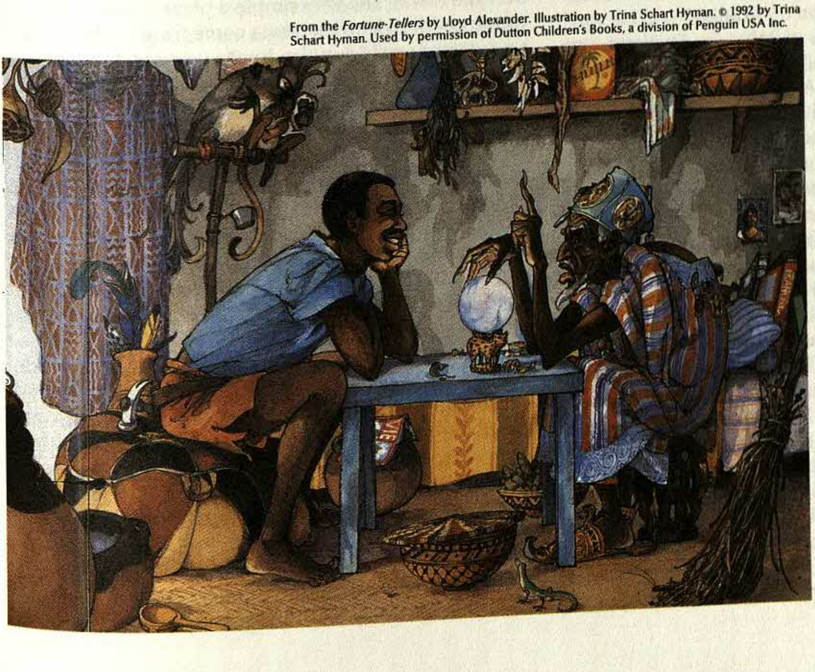

ANNO'S AESOP
A BOOK OF FABLES BY AESOP AND MR. FOX • RETOLD AND ILLUSTRATED BY
MITSUMASA ANNO

Illustration and original Japanese text (1987) by Mitsumasa Anno. English text (1989) by Orchard Books, New York City

Fables use entertaining animal characters to illustrate moral lessons. *Anno's Aesop* is a retelling of *Aesop's Fables.*

Fantasy can either be set in a world that looks like ours, such as Alan Garner's *The Weirdstone of Brisinga-*

From the *Fortune-Tellers* by Lloyd Alexander. Illustration by Trina Schart Hyman. © 1992 by Trina Schart Hyman. Used by permission of Dutton Children's Books, a division of Penguin USA Inc.



The Fortune-Tellers is a fantasy set in the African country of Cameroon. The main characters are an old fortune teller and a young carpenter who dreams of power, riches, and romance.

Illustration by the author from *Where the Wild Things Are* by Maurice Sendak

Illustrations play an important part in most children's books. A menagerie of monsters in Maurice Sendak's *Where the Wild Things Are, above,* comes to life in the imagination.

men (1960), or in a totally different world, like Ursula Le Guin's *Earthsea* quartet (1967-1990), or Lloyd Alexander's *Prydian* cycle (1963-1968). In other books the characters can move between reality and fantasy, as they do in C. S. Lewis' tales of the land of Narnia, *The Lion, the Witch, and the Wardrobe* (1950) and its sequels. Many fantasies use talking animals as characters, a tradition that goes back to the fables. The most famous of these books in the United Kingdom is probably Kenneth Grahame's *The Wind in the Willows* (1908), which features Badger, Rat, Mole, and Toad as river-bank friends. The U.S. classic, E. B. White's *Charlotte's Web* (1952), centres on the friendship between a spider and a pig. Some of the best Australian children's books, such as Norman Lindsay's *The Magic Pudding* (1918), are in the same tradition.

Perhaps the most famous Italian children's fantasy is *Pinocchio* (1883), by Carlo Collodi, the story of a wooden puppet who comes to life. Michael Ende's fantasy quest story, *The Neverending Story,* originated in Germany, a country with a long tradition of folk tales. A much-loved French series of books by Jean de Brunhoff and his son Laurent tell of the adventures of Babar the Elephant. One of the best books to teach children tolerance of people different from themselves is André Maurios' *Fattipuffs and Thinifers* (1930). One of the most translated authors from Scandinavia is the Finnish writer Tove Jansson, whose series of fantasies began with *Finn Family Moomintroll* (1948). Another is Astrid Lindgren of Sweden, who wrote the "Pippi Longstocking" series about a very strong and eccentric female heroine.

The adventure story lies somewhere between fantasy and realism. In the 1800's, adventure stories were written largely for boys. In the 1900's, they featured heroes such as "Biggles" in the UK, the Hardy boys in the U.S.A., and Simon Black in Australia. Increasingly, female heroines such as Nancy Drew became popular. Romances such as the "Sweet Valley High" series have also been bought in huge numbers by girls all over the world.

Mystery and detective stories, science fiction, and even horror stories are popular with young readers. In *The House of Dies Drear* (1968) by Virginia Hamilton, a 13-year-old boy finds buried treasure in a mysterious old house. Robert Newman's *The Case of the Frightened Friend* (1984) introduces enterprising young detectives who investigate the mystery of a classmate's family.

More recently, children's books, especially in the U.S.A., have turned to realistic themes, including divorce, racial prejudice, violence, illness, and death. Teachers use such stories to help children come to terms with issues that may be worrying them.

Picture books. More original work for children has been produced in the picture book than in perhaps any other kind of book. Some of the earliest picture books were produced in Germany, including F. J. Burtuch's *Picture-book for Children* in 24 volumes beginning in 1790. Cheap colour printing began in the late 1800's, and the first colour magazine for children, *Boys of the Empire,* was published in England in 1888.

India's first picture book in English, *Home,* by Kamla Nair and K. S. Kaulkarni, was published in 1965. Japan has had a long history of children's books, and its picture books are particularly famous. The books of Mitsumasa Anno, with their detailed pictures, have sold all over the world. The very simplest picture books for young children by Dick Bruna come from Holland and are internationally popular. Books using cartoon strips have become widely acclaimed. Goscinny and Uderzo's *Asterix the Gaul* series from France, Hergé's "Tin Tin" series from Belgium, and Raymond Briggs's *Father Christmas* (1973) and *The Snowman* (1978) from England have all been filmed.

Some of the most inventive picture books come from Australia, by authors such as Jan Ormerod, Bob Graham, and Julie Vivas. New Zealand has produced Ronda Armitage's *The Lighthouse Keeper's Lunch* (1977) and Lynley Dodd's the *Hairy Maclary from Donaldson's Dairy* series.

Picture books in the U.S.A. were greatly influenced by immigrants from Europe, such as the Hungarian Kate Seredy and Ludwig Bemelmans, who was born in a part of Austria that is now in Italy. Bemelmans is famous for his books set in France about the schoolgirl Madeline. Picture books are the most international form of writing, and many have been translated, such as the Frenchman Marcel Aymé's *The Wonderful Farm* (1950), and the work of Reiner Zimnik from Germany.

Picture books now deal with very serious subjects. *Rose Blanche* (1985), by Roberto Innocenti and Christophe Gallazis, is about the Holocaust, and Toshi Maruki's *Hiroshima no Pika* (1982) and Junko Morimoto's *My Hiroshima* (1987) deal with the bombing of Hiroshima. The British author Anthony Browne's books about lonely children, such as *Gorilla* (1983), are read all over the world.

Information books are very popular, and have a tradition going back to the *Orbis Pictus* by Comenius (1658). Current books range from large encyclopedias, such as *The World Book Encyclopedia,* which was first published in 1917, to series that deal with almost any imaginable subject. David Macaulay's series of books, which include *Castle* (1977), look inside structures in great detail and show how they were built.

History

Childhood is different in different parts of the world and has changed over the centuries. The literature that people think is suitable for children has changed a great deal too. In the West, there is a huge variety of children's literature, dealing with almost every subject, including racial conflict, sex education, drug abuse, children's rights, and death. In earlier times, such subjects would not have been allowed in children's books. In other countries, such subjects are still banned.

Early children's literature. Before the printed book, children shared the oral storytelling of adults. When books first began to be printed, children read fables and religious writings. One of the first books printed by William Caxton in England was *Aesop's Fables* (1484), taken from ancient Greek stories.

The church in England disapproved of reading books for fun, and disapproved of the fables sold by pedlars. Children were instead given sermons, which were often grim and frightening. A famous example is James Janeway's *A Token for Children* (1692), which told of the holy lives and "joyful deaths of several young children." One classic book of the time, which is still read by children and adults, is John Bunyan's *The Pilgrim's Progress* (1678). Severe Puritan books were also written in the U.S.A., including the *New England Primer,* written in the late 1600's by Benjamin Harris, an Englishman living in the U.S.A. These books often contained rhymed alphabets, and were illustrated by crude woodcuts.

At the beginning of the 1700's, more people began to read, and more books of fiction were published. Children were able to read more widely, and adopted adult books such as Daniel Defoe's *Robinson Crusoe,* and Jonathan Swift's *Gulliver's Travels.* These books originally had serious religious or political purposes, but they were soon simplified for children. *Robinson Crusoe,* the story of a man shipwrecked on a desert island, was imitated by many hundreds of writers. Nearly a hundred years later, a Swiss clergyman wrote *The Swiss Family Robinson,* which in turn inspired Captain Marryat to write the shipwreck adventure *Masterman Ready* in 1841. Some famous novels of the 1700's, including the first novel, Samuel Richardson's *Pamela,* were rewritten for children. Fairy tales were imported from France. They were intended for adults to read, but they were soon taken up by children.

Ring-a-ring-a-roses,
A pocket full of posies ;
Hush! hush! hush! hush!
We're all tumbled down.
KG

Illustration by Kate Greenaway from *Mother Goose* (1881)

Mother Goose fairy tales, rhymes, and songs have charmed young children since the 1700's.

In 1744, Mary Cooper, a London bookseller, published the first known collection of nursery rhymes, entitled *Tommy Thumb's Song Book.* Another bookseller, John Newbery, published *A Little Pretty Pocket Book,* which was designed to make learning fun for the first time. It was sold with a ball for boys to play with and a pincushion for girls. Newbery and his family went on to publish many hundreds of books, including *The History of Little Goody Two-Shoes,* which was probably written by the famous playwright, Oliver Goldsmith. The first novel for children was Sarah Fielding's *The Governess* (1749), which tells stories about the girls at Mrs. Teachum's "Little Female Academy."

The 1800's. In England, many thousands of religious pamphlets were written for children. Novels such as Mrs. Sherwood's *The History of the Fairchild Family* (1818) were written to teach strict lessons in morality and aimed to instil fear in the reader. The first book to show children behaving much as they do today, with adults treating them with sympathy, was Catherine Sinclair's *Holiday House* (1839). After that, children's books became more fun. In 1846, the same year that Edward Lear published his *Book of Nonsense,* Hans Christian Andersen's fairy tales, including the stories of "Thumbelina" and "The Little Mermaid," were translated into English. Collections of Norwegian folk tales by Peter

Illustration for "John Gilpin's Ride" from *R. Caldecott's Picture Book No. 1* (1879)

Great illustrators of the 1800's, including Randolph Caldecott, helped make pictures a major part of children's literature.

Asbjørsen and Jørgen Moe appeared in the 1840's, with stories such as "The Three Billy Goats Gruff." In the U.S.A. in 1823, a poem was published in a New York State newspaper that was to become part of American life. It was "A Visit from St. Nicholas", and it begins "'Twas the night before Christmas . . ."

In England, there were two main kinds of writing, one for boys and one for girls. Writers like Charlotte Yonge, Mrs. Molesworth, Hesba Stretton, and "A.L.O.E." ("A Lady of England"), produced hundreds of books in which little girls help the poor and needy and live happy lives at home. The very best of this kind of book were written by Frances Hodgson Burnett, an Englishwoman living in the U.S.A. In Hodgson Burnett's *A Little Princess,* the rich Sara Crewe loses all her money and is badly treated by the wicked Miss Minchin. *The Secret Garden* tells the story of a sour little girl and a sick little boy who grow to be happy and healthy through the influence of nature. Mrs. Molesworth also introduced magic into her stories. The cuckoo comes to life and talks to Griselda in *The Cuckoo Clock* (1877). One of the most famous European books of this time was from Switzerland, Johanna Spyri's *Heidi* (1873).

Writers for boys concentrated on the school story, such as *Tom Brown's Schooldays* by Thomas Hughes, and adventure stories such as those written by Captain Marryat and R. M. Ballantyne. By the end of the 1800's, G. A. Henty, W. H. G. Kingston, and others were turning out hundreds of books set in different parts of the British Empire. Many of these had historical settings and were intended to educate as well as to entertain their readers. Today, they often seem to be very racist in their attitudes.

In India, the oral storytelling tradition was strong. When the British colonized India, they brought with them the idea of a separate literature for children. The School Book Society distributed English books in the 1800's, but there were also children's books in Hindi, by authors such as Raja Shivprasad. The first Indian magazine for children, *Digdarshan,* was published in Bengali in 1818.

In the U.S.A., girls were also given books with strong moral sentiments, but the heroines had much more freedom, and stronger characters. This led to their popularity in England. *What Katy Did* (1872), *Little Women* (1868), and *Pollyanna* (1912) are still enjoyed today, as are the Canadian *Anne of Green Gables* (1908) and the Australian *Seven Little Australians* (1894). A fashion for books about naughty boys was set in the U.S.A. by Thomas Aldrich in 1869 with *The Story of A Bad Boy.* The most famous of these books was Mark Twain's *Tom Sawyer* (1876), which is a mixture of everyday life and very dramatic adventure set in the town of Hannibal, Missouri.

The period 1860 to 1920 is often described as the "golden age" of children's books. Lewis Carroll's *Alice's Adventures in Wonderland* (1865) and *Through the Looking Glass* (1871) have become classics, known also for their original illustrations by Sir John Tenniel (see **Tenniel, Sir John** [picture]). Writers like Edith Nesbit and Rudyard Kipling created a friendly, straightforward way of writing for children that has been imitated a great deal. Nesbit wrote *The Story of the Treasure Seekers* (1899), about children trying to restore the family fortunes and *Five Children and It* (1902), about meeting a fantastic creature who grants magic wishes. Kipling's *The Jungle Book* (1894) contains several stories about Mowgli, a boy brought up with a wolf-pack in India. Kip-

The first modern picture book was *The Tale of Peter Rabbit,* one of a series of animal stories written by Beatrix Potter. The author also illustrated the stories with delicate watercolours.

ling's *Just-So Stories* (1902), which were originally told to his children, include "How the Elephant Got His Trunk" and "How the Camel got his Hump." Robert Louis Stevenson's *Treasure Island* (1883) proved that dramatic adventures could have lasting value. The most memorable character in the book is the murderous pirate Long John Silver.

In Australia, New Zealand, and Canada, with their relatively small populations at this time, children's books developed slowly. Ethel Turner's *Seven Little Australians* (1894) was rather like the girls' novels of Louisa M. Alcott, except with an Australian setting. Stories set in the outback were becoming popular by the early 1900's. Mary Grant Bruce's *Mates at Billabong* (1910) was the first of fifteen books about a sheep station (ranch). The first children's book set in New Zealand, *Stories about Many Things,* was published in 1833.

Canadian literature was influenced by the U.S.A. and the UK, and although it produced some early magazines for children, such as *Snowdrop* (1847), it was not until the 1900's that much fiction was written. Realistic books were most common, notably Ernest Thompson Seton's *Red Fox* (1905), and the series of nine books by L. M. Montgomery about a girl's life on Prince Edward Island, beginning with *Anne of Green Gables* (1908).

Illustrated books became important in the late 1800's, as new printing processes made the printing of colour pictures both better and cheaper. Influential illustrators in England included Randolph Caldecott, Walter Crane, Kate Greenaway, and Arthur Rackham. The most internationally successful artist was Beatrix Potter, whose little "Peter Rabbit" books, with their delicate watercolour illustrations, have been translated into many languages. In the U.S.A., Howard Pyle, N. C. Wyeth, and Maxfield Parrish were the most original illustrators.

Illustration by Ernest Shepard (1926)

Winnie-the-Pooh by A. A. Milne is a famous book about a boy and his adventures with his collection of stuffed toy animals.

The 1900's. Because children's books are written by adults, they often reflect very clearly the mood of the adult world. After World War I (1914-1918), children's books emphasized quietness and security. A. A. Milne's *Winnie-the-Pooh* (1926) and *The House at Pooh Corner* (1928) are small, gentle stories of Christopher Robin and his toys: the rather stupid Pooh Bear, his timid friend Piglet, the gloomy donkey Eeyore, and others. They have been among the most popular children's books ever written. In the U.S.A., Laura Ingalls Wilder's story of her childhood as a pioneer in the American Midwest, beginning with *Little House in the Big Woods* (1932), empha-

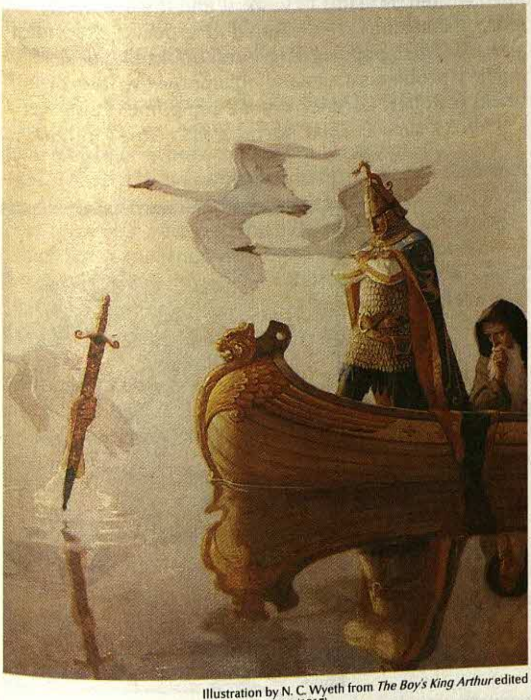


Illustration by N. C. Wyeth from *The Boy's King Arthur* edited by Sidney Lanier (1917)

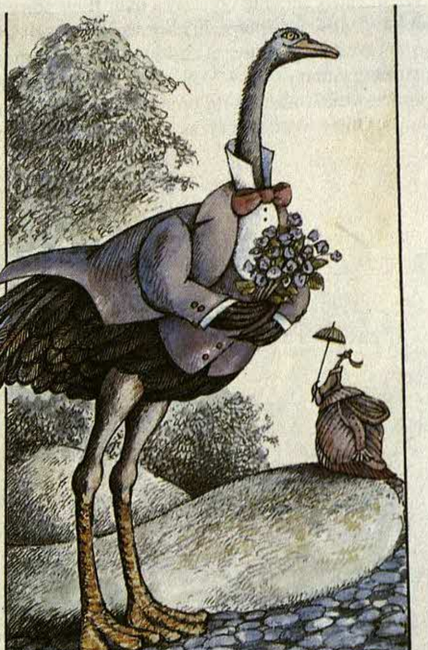


Illustration by the author from *Fables* (1980) by Arnold Lobel

Great illustrators of the 1900's include N. C. Wyeth and Arnold Lobel. Wyeth became known for his dramatic illustrations of children's classics, such as *The Boy's King Arthur, left.* Lobel gained popularity for his delightful pictures of animals in such books as *Fables, right.*

sized independent living. Also popular were stories of small-town life, like Maud Hart Lovelace's *Betsy-Tacy* books. In England, Arthur Ransome's *Swallows and Amazons* series described children "messing about with boats" and having other outdoor adventures.

Another way of escaping from the real world was to read fantasy. In 1937, a British scholar, J. R. R. Tolkien published *The Hobbit* and introduced readers to the world of Middle Earth, peopled with hobbits, elves, dwarfs, trolls, orcs, and dragons. *The Hobbit* was a children's book, and many children have enjoyed its sequel, written for adults, the three-volume epic *The Lord of The Rings* (1954-1955).

Perhaps the most famous German book of this time was Felix Saltern's *Bambi* (1923). During the 1930's in Germany, many books were banned by the Nazi Party, including Erich Kästner's classic story *Emil and the Detectives* (1929). Very few serious children's books were written about World War II (1939-1945), until many years later, when the children who had lived through the war grew up. At the time, popular fictional heroes included "Biggles," the British air force pilot.

After World War II, children's literature became a major industry, producing everything from board books for the very youngest readers, to "young adult" novels that dealt with adult themes.

The most popular writer in the UK has been Enid Blyton, whose 600 books included series such as the "Famous Five" and the "Secret Seven." Her books have been criticized for the simplicity of their ideas and language, but have sold millions of copies. More well-known internationally is Roald Dahl, whose most famous book is *Charlie and the Chocolate Factory* (first published in the U.S.A. in 1964). Despite concerns over their sometimes cruel and violent content, his books have been bought and enjoyed by millions of children. A classic modern Australian fantasy is S. A. Wakefield's *Bottersnikes and Gumbles* (1967), about odd creatures who live in rubbish dumps. Other writers such as William Mayne, Jan Mark, and Alan Garner in the UK, Katherine Paterson, Cynthia Voight, Virginia Hamilton in the U.S.A., Margaret Mahy in New Zealand, and Patricia Wrightson and Ivan Southall in Australia have written books of the highest literary standard.

Dr. Seuss (Theodore Seuss Geisel) wrote a series of "beginner books" with eccentric pictures and extravagant rhymes for younger readers. Perhaps the best-known of these was *The Cat in the Hat* (1957). Another internationally successful series has been the adventures of Thomas the Tank Engine and his friends, by the Rev. W. Awdrey.

Original stories were published in the *School Journal,* a magazine produced by the New Zealand government's department of education and sent out to all New Zealand schools. It was here that the most famous of all New Zealand children's writers, Margaret Mahy, was first published. She has since won many awards for her picture books and novels, and has twice won the British Carnegie Medal with *The Haunting* (1982) and *The Changeover* (1984). Australian writers such as James Aldridge, Nadia Wheatley, Gary Crew, and Colin Thiele are known the world over. Canadian writers like Robert Munsch, whose heroine in *The Paper Bag Princess* does not marry the prince, are also internationally popular.

Picture books have continued to be experimental, and the work of illustrators such as Maurice Sendak, John Burningham, Chris Van Allsburg, Julie Vivas, and Raymond Briggs has come to appeal to adults almost as much as to children.

By the 1990's, publishing for children was dominated by carefully designed series of romances, "choose your own adventure" books, or horror stories. These are often written by teams of writers, and the characters, plots, and settings are designed to appeal to the widest audience. Also popular have been books that deal with modern problems. Outstanding amongst writers of such books is Robert Cormier, whose sometimes controversial books, such as *The Chocolate War* (1974) and *After*

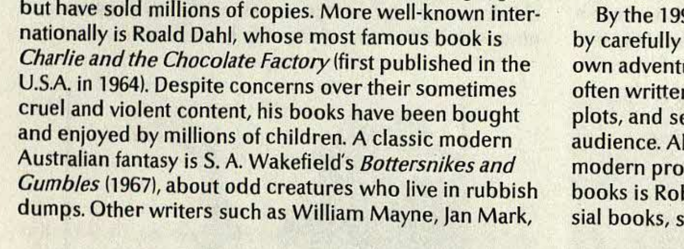


Illustration by Harold F. Heady from *High Meadow* by Eleanor B. Heady and Harold F. Heady

An information book on ecology describes how moisture rises from the earth, collects in the sky as clouds, and then falls back to earth as rain and snow.

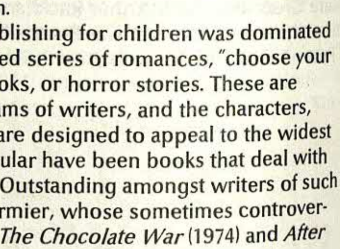


Illustration (1900) by W. W. Denslow from *The Wizard of Oz* by L. Frank Baum

Fantasies—like *The Wizard of Oz*— are thrilling tales of imaginary lands.

Illustration from *This Place Is Crowded* © 1992 by Barbara Lavallee. Reprinted with permission from Walker and Company. All rights reserved.

This Place Is Crowded **describes education, holidays, transportation, and other ways of life and customs in the crowded island country of Japan.**

The First Death (1979), deal with violence, corruption, and terrorism.

Children's nonfiction. In the 1800's, information books were very popular in the U.S.A., especially those written by Samuel Goodrich under the name of "Peter Parley". These were imported into England, and much imitated. In the 1900's, information books have become part of the educational system, and several of them have won major prizes. Hendrik van Loon, for example, won the first American Newbery Medal for the best children's book of 1922 with *The Story of Mankind.* Information books are now usually produced in sets and series by specialist publishers using the most modern photographic techniques.

Children's magazines. The first magazines for children were probably published in Britain in the 1700's by John Newbery, whose *Lilliputian Magazine* appeared in 1751. The first to be published in Spain was *La Gaceta de los Niños* (1798). Many of the magazines published in the next 100 years were religious. *Peter Parley's Magazine,* which was concerned with facts, was very successful. Magazines for children were an important part of children's reading in Russia in the 1800's, and the first French children's magazine was *Le Journal des Enfants* (1833).

In the UK and the U.S.A. in the 1800's, children read magazines that contained adventure stories, often laced with horror and violence. These were known in England as "penny dreadfuls" and in the U.S. as "dime novels." To combat their influence, magazines such as Charlotte Yonge's *Monthly Packet* (from 1851), and *The Boy's Own Paper* (produced by the Religious Tract Society from 1879) were founded. Magazines were very important in the U.S.A., and in the late 1800's much of the best writing for children first appeared in magazines like *St. Nicholas, Our Young Folks,* and *Wide Awake.* These magazines were widely read by the children of pioneer families.

In the 1900's, although there are many thousands of magazines and comics designed for children, only a very few, such as the *School Journal* in New Zealand, and Marianne Carus' *Cricket* in the U.S.A. set out to combine entertainment and education.

Related articles in ***World Book*** include:

Ballad
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Caldecott Medal
Encyclopedia
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Fable
Fairy
Folklore
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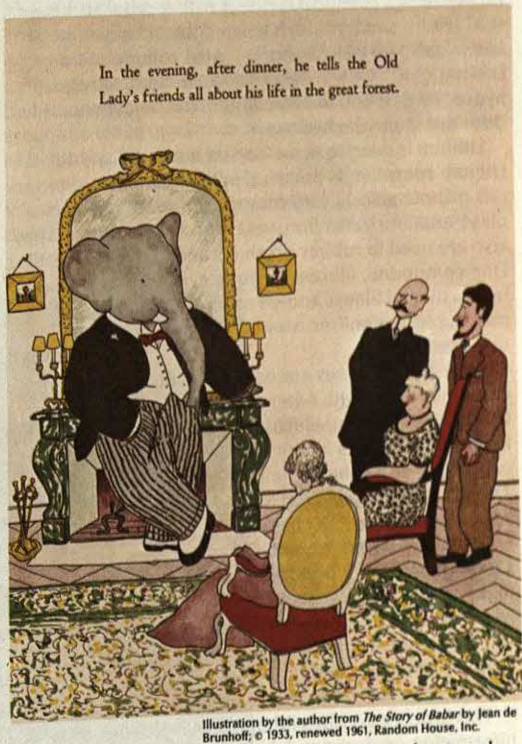
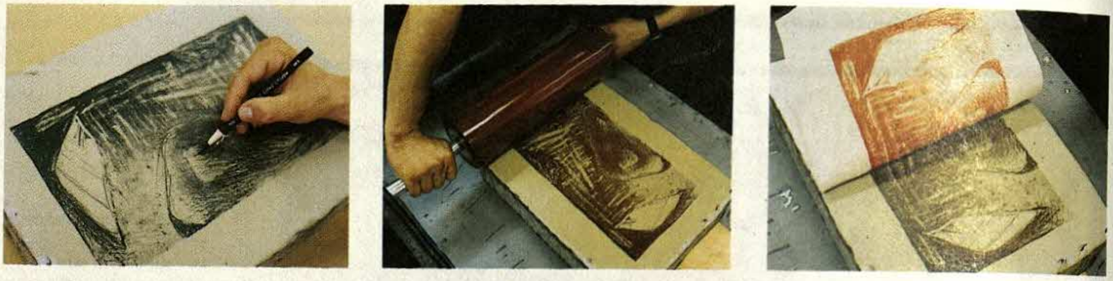


In the evening, after dinner, he tells the Old Lady's friends all about his life in the great forest.

Illustration by the author from *The Story of Babar* by Jean de Brunhoff; © 1933, renewed 1961, Random House, Inc.

The Story of Babar is a French children's classic about an elephant who runs away from the jungle to live in Paris.



Making a lithograph. The artist draws on a lithographic stone with a greasy crayon, *left.* The artist dampens the stone with water and applies ink that sticks to the drawing but not to the rest of the stone, *centre.* Then a sheet of paper is pressed against the inked stone to make a print, *right.*

Litharge, also called *lead monoxide,* (chemical formula, PbO), is a poisonous yellow or reddish-yellow solid, a compound of lead and oxygen. It is made by heating lead or certain of its compounds in air. Litharge is used in making lead glass, pottery glazes, and rubber.

Lithgow (pop. 12,369) is an industrial city in New South Wales, Australia. It lies 975 metres above sea level in the Blue Mountains, about 150 kilometres west of Sydney. The Council of the City of Greater Lithgow administers an area of about 3,470 square kilometres.

Lithgow's small arms factory, owned by the federal government, is the largest precision engineering works in the Southern Hemisphere. Major power stations at Wallerawang and Mount Piper use coal from local mines and employ many people from the city. Other industries include steel fabrication and clothing and textile manufacturing.

Lithium is a chemical element with symbol Li. It is a soft, silvery-white metal. It is the lightest known metal and is only half as heavy as an equal volume of water. Lithium reacts with water, as does sodium, to release hydrogen gas. But, unlike sodium, the reaction usually does not ignite the hydrogen.

Lithium is used to make certain types of batteries. Lithium compounds are used in the manufacture of various materials, including ceramic products, enamels, glass, and lubricants for use at high temperatures. They also are used in rubber products and in dyes for textiles. One compound, lithium carbonate, is used as a drug to treat a mental illness known as *bipolar disorder,* or manic depression (see **Mental illness** [Affective disorders]).

Lithium metal does not occur in nature because it combines easily with other elements. Chemists obtain the metal by passing electricity through *fused* (melted) lithium chloride. Its atomic number is 3, and its atomic weight is 6.941. Lithium melts at 180.54 °C and boils at 1347 °C. It was discovered in 1817 by Johann August Arfvedson, a Swedish chemist.

See also **Alkali; Element, Chemical.**

Lithography is a printing process that has an important part in the fine arts and in commercial printing. Many artists have created lithographs that rank among the masterpieces of printmaking. Commercially, lithography is a leading method of printing books, magazines, newspapers, and other publications.

This article describes lithography in the fine arts. For information on commercial lithography, see the article on **Printing** (Printing by offset lithography).

How lithography works. Lithography is based on the principle that water does not mix with grease. The artist draws the picture on a level porous surface with a grease pencil, a crayon, or a greasy liquid called *tusche.* The most common surfaces are limestone or a plate made of a material such as aluminium, paper, or zinc with a specially prepared surface. The grain of the stone or plate enables the artist to create lithographs with a broad range of tones and textures.

After drawing the picture, the artist treats both the drawn and undrawn areas of the surface with solutions of nitric acid and gum arabic. The gum arabic surrounds the grease drawing and chemically prevents ink from sticking to the undrawn areas. The acid allows the grease and gum arabic to be more easily absorbed into the pores of the stone or plate. After applying the solutions, the artist uses turpentine to dissolve and remove drawing materials remaining on the surface of the stone or plate.

The artist then dampens the surface with water. The undrawn areas absorb water, but the greasy drawn areas reject it. The artist applies an oil-base ink to the surface with a roller. The ink sticks to the greasy areas but not to the wet ones.

Next, the artist places a sheet of paper on the printing surface and runs the paper and the stone or plate through a printing press under heavy pressure. The pressure transfers the inked design onto the paper. To make additional impressions of the picture, the artist redampens and reinks the surface.

Colour lithography. To make a lithograph in more than one colour, the artist must prepare a separate surface for each colour. For example, the picture may show green grass and a red house. On one surface, the artist draws the grass, which is printed with green ink. The house is drawn on a second stone or plate and then printed in red ink. The artist puts the paper through the press twice, once for each colour of the total design. The artist must draw the grass and house so they appear in exactly the correct *registration* (relationship to each other) in the lithograph. Images printed on limestone or on zinc plates produce coloured pictures having an especially luminous quality.

Artists achieve unusual effects by combining lithography with other printmaking processes, such as silkscreen printing. Many artists have created lithographs by adapting new processes of commercial printing.

See also **Bellows, George W.; Currier and Ives; Daumier, Honoré; Senefelder, Alois.**

Lithuania is a European nation that regained its independence in 1991, after more than 50 years of forced annexation to the Soviet Union. Lithuania lies on the eastern shore of the Baltic Sea. It had been independent from 1918 to 1940, when the Soviet Union occupied it and made it one of the 15 republics of the Soviet Union.

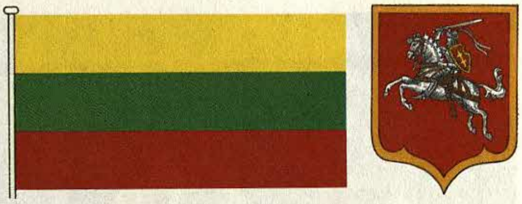
Lithuania covers 65,200 square kilometres. For Lithuania's total population, see the *Facts in brief* table with this article. Vilnius is Lithuania's capital and largest city. The country's name in Lithuanian, the official language, is Lietuvos Respublika (Republic of Lithuania).

Government. Lithuania is a republic. The president is the highest government official and is elected by the people to a five-year term. The president appoints a prime minister. Lithuania's parliament is called the Seimas. The 141 members of the Seimas are elected by the people to four-year terms. The Supreme Court is Lithuania's highest court. Other courts include the Court of Appeals and the Constitutional Court.

Under Soviet rule, the Communist Party was Lithuania's only political party. Since 1989, other parties have been allowed. The Democratic Labour Party, which changed its name from the Communist Party, is the largest party. Other parties include the Christian Democratic Party and the Social Democratic Party.

Facts in brief about Lithuania

Capital: Vilnius.
Official language: Lithuanian.
Official name: Lietuvos Respublika (Republic of Lithuania).
Area: 65,200 km². *Greatest distances*—north-south, 280 km; east-west, 375 km.
Elevation: *Highest*—Juozapines, 292 m. *Lowest*—sea level along the coast.
Population: *Estimated 1996 population*—3,782,000; density, 58 people per km²; distribution, 72 per cent urban, 28 per cent rural. *1989 census*—3,689,779. *Estimated 2001 population*—3,845,000.
Chief products: *Agriculture*—beef cattle, dairy products, pigs *Manufacturing*—chemicals, fabricated metal products, electrical equipment, machinery, food products, petroleum products.
Money: *Currency unit*—litas. One litas = 100 cents.



Symbols of Lithuania. Lithuania's flag has three horizontal stripes. The yellow stripe stands for fields of ripening grain. The green stripe represents Lithuania's evergreen forests. The red stripe symbolizes the blood shed for freedom. Lithuania's coat of arms features a knight on a white horse.

People. About 80 per cent of the people of Lithuania are Lithuanians, a nationality group that has its own customs and language. About 9 per cent of the population are Russians, and a somewhat smaller number are Poles. Less than 1 per cent are Jews. Before World War II (1939-1945), about 8 per cent of the population were Jews, but the Nazis killed most of them during the war.

About 90 per cent of the Lithuanians are Roman Catholics. Most of the rest belong to the Lutheran Church. Lithuania's culture developed under Roman Catholic influence, and Catholic traditions are retained.

Under Soviet rule, the government made the practice of many of the old Lithuanian customs very difficult. For example, Soviet laws forbade religious instruction, religious publications, and charity work. The Soviet government also discouraged church attendance. In 1988, the Soviet restrictions on religion in Lithuania ended.

Lithuania was a rural society until the Soviet conquest. About three-quarters of its people lived in rural villages. The Soviet government industrialized the country. The government took away private land and combined small farms into large state-owned farms. It built many factories, and large numbers of people moved from rural areas into cities to work in these factories. Today, about two-thirds of the people live in urban areas.

Lithuanians wear clothing similar to that worn in Western countries. But they cherish their decorative national costumes and wear them on festive occasions.

Vilnius, the capital and largest city of Lithuania, lies along the Neris River. The city is a major cultural and industrial centre. It is famous for its many old churches, some of which date from the 1400's. Modern high-rise buildings stand among the older structures.

Traditional folk costumes brighten special Lithuanian celebrations, such as the festival shown above. But Lithuanians usually dress much as people in Western countries do.

For recreation, Lithuanians especially enjoy singing and sports, particularly basketball, boxing, rowing and soccer. Choral singing is highly developed in Lithuania, and thousands of people sing and dance in annual festivals. These festivals have become a Lithuanian tradition since the 1920's, and they attract huge crowds of spectators from throughout the republic. Many ancient Lithuanian songs, called *dainos,* and folk tales have been handed down in spoken form for generations. Lithuania has 11 theatres where ballet, drama, and opera are performed, and it also has a film industry.

Lithuanian children must go to school from the age of 6 to 17. Lithuania has 14 universities and colleges. The State University in Vilnius was established in 1579.

Land and climate. Most of Lithuania consists of flat or gently sloping land. The highest elevations are in the southeast. The land dips down to central lowlands and rises slightly in the west. White sand dunes along the seacoast provide a popular resort area. The dunes are especially attractive on a long strip of land that separates a lagoon from the Baltic Sea.

The country has about 3,000 small lakes and hundreds of rivers. The lakes cover about $1\frac{1}{2}$ per cent of Lithuania. The longest and largest river is the Neman (called Nemunas in Lithuanian). It begins in Belarus, which lies to the southeast, and drains most of Lithuania during its course to the Baltic.

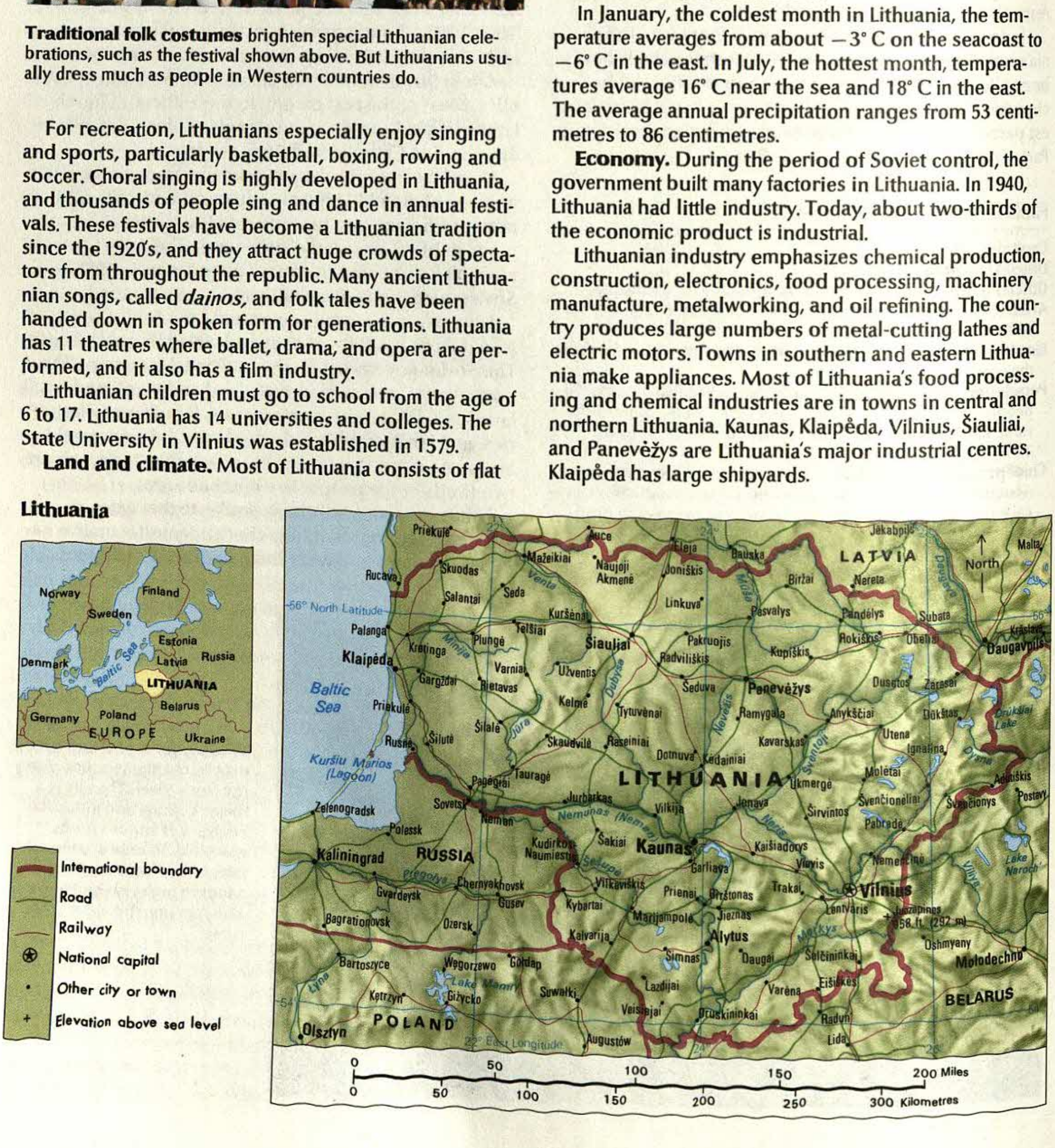
Lithuania has no large, important mineral deposits. Its natural resources include clays and sands, gypsum, limestone, peat, dolomite, amber, and small amounts of oil. Forests cover about a fourth of the land. Small quantities of oil have been discovered in western Lithuania and offshore in the Baltic Sea.

In January, the coldest month in Lithuania, the temperature averages from about $-3°$ C on the seacoast to $-6°$ C in the east. In July, the hottest month, temperatures average 16° C near the sea and 18° C in the east. The average annual precipitation ranges from 53 centimetres to 86 centimetres.

Economy. During the period of Soviet control, the government built many factories in Lithuania. In 1940, Lithuania had little industry. Today, about two-thirds of the economic product is industrial.

Lithuanian industry emphasizes chemical production, construction, electronics, food processing, machinery manufacture, metalworking, and oil refining. The country produces large numbers of metal-cutting lathes and electric motors. Towns in southern and eastern Lithuania make appliances. Most of Lithuania's food processing and chemical industries are in towns in central and northern Lithuania. Kaunas, Klaipėda, Vilnius, Šiauliai, and Panevėžys are Lithuania's major industrial centres. Klaipėda has large shipyards.

Lithuania



Lithuanians celebrated independence in September 1991, when the Soviet Union recognized Lithuania as an independent nation. Lithuania had been under Soviet rule for over 50 years.

Lithuanian agriculture specializes in dairy and meat production. Agriculture accounts for about a quarter of the country's economic output. Lithuania also has a large fishing fleet.

Under Soviet rule, the government owned most businesses, factories, and farms. But in the late 1980's, it began to allow private businesses. By the mid-1990's, most businesses were privately owned. In 1990, the government began to allow private ownership of farmland. By the mid-1990's, much of the farmland was under private control.

History. People lived in the region that is now Lithuania from about 8000 B.C. Groups that were the ancestors of the Lithuanian people lived there at the time of Christ.

In the A.D. 100's, the Roman historian Tacitus made the first historical mention of the people who lived near the Baltic Sea. He reported that they sold amber to the Romans. Near the end of the 1100's, the Lithuanian peoples inhabiting the area united into a single nation. The first great ruler of Lithuania was Mindaugas, who became king in 1251. Mindaugas was assassinated by nobles in 1263.

In the 1200's, the people fought a group of German crusaders called the Teutonic Knights, who tried to conquer Lithuania (see **Teutonic Knights**). Lithuania expanded its boundaries in the 1300's. In time, it extended nearly to Moscow in the east and to the Black Sea in the south. In 1386, Grand Duke Jagiełło (Jogaila in Lithuanian) united Lithuania with Poland. At first, this union was a confederation of two states ruled mostly by the same king. They were made a single state in 1569.

The Lithuanian-Polish government collapsed in the 1700's, and in 1795 Lithuania came under the rule of the czar of Russia. The people rebelled against Russian rule in 1831 and 1863 but failed to win independence. The czar prohibited books printed in Lithuanian and closed Lithuanian schools. But the people continued to educate their children and kept the national culture alive.

The movement for an independent Lithuania became organized in the 1880's. In 1905, a conference of elected representatives of Lithuania demanded self-government for their people within the Russian state. The Russians rejected this demand. During World War I (1914-1918), German troops occupied Lithuania. On Feb. 16, 1918, Lithuania became the first of the Baltic States to declare its independence from Russia and Germany (see **Baltic States**). Lithuania established a democratic system of government. A land-reform programme broke up large estates and distributed land among the poor.

Fighting continued in Lithuania after World War I ended. Russia attempted to take over the country. The Lithuanians defeated the Russians, and a peace treaty was signed in 1920. Poland occupied Vilnius in 1920, and held the city until 1939. In 1926, a group of military officers and civilian politicians seized power in Lithuania. Antanas Smetona became president. He gradually took over more and more of the authority that the president had shared with the parliament.

In March 1939, Germany seized part of Lithuania. A combination of Lithuanian political parties tried to restore democracy, but failed. Later in 1939, Germany and the Soviet Union, a federation of republics founded under Russia's leadership in 1922, agreed to divide Eastern Europe between themselves. Under this agreement the Soviet Union gained control of the Baltic region. The Soviet government built military bases in Lithuania.

In 1940, the Soviet Union occupied all of Lithuania and made it a Soviet republic with a Communist government. After the Germans invaded the Soviet Union in 1941, the Lithuanians revolted against their Soviet rulers and established their own government. But the Germans suppressed the government. They conquered the country and occupied it until 1944, when the Soviet Union again took over Lithuania. From 1944 to 1952, Lithuanian guerrillas fought the Soviet Union. Thousands of the guerrillas were killed. The Soviet government also sent about 350,000 Lithuanians to labour camps.

In 1972, many Lithuanian students and young workers demonstrated against the Soviet government, and several people burned themselves to death in protest. Lithuanians continued to express their opposition to Soviet rule, particularly after the mid-1980's, when Soviet leader Mikhail Gorbachev began calling for more openness in Soviet society. In 1988, Lithuanian intellectuals established the Sajūdis, a non-Communist movement that sought to give Lithuania complete control of its economy, citizenship requirements, education, and cultural development. It also sought to clean up Lithuania's rivers and lakes, and the Baltic Sea shores, all of which had been severely damaged by pollution from industries. Most members of this and similar movements sought total independence and separation from the Soviet Union. Lithuanians supported these goals by staging public demonstrations. They also elected representatives who supported their movement to the Soviet parliament that was created in 1989.

In 1989, Lithuania's parliament expressed a commitment to full independence. It declared that laws adopted by the Soviet parliament were invalid in Lithuania unless approved by the Lithuanian parliament. The government declared Lithuanian the official language. It also allowed freedom of religion and the press.

On Dec. 7, 1989, the Lithuanian parliament abolished the monopoly of power that the Communist Party had held since 1940. It established a multiparty political system. Parliamentary elections were held in February 1990. A pro-independence coalition led by Sąjūdis won more than 90 per cent of the parliamentary seats. On March 11, the new parliament declared an immediate restoration of Lithuania's independence as a nation. The Soviet Union demanded a recall of the declaration. But the Lithuanians refused. In response, the Soviet Union applied economic pressure. It cut off all of its shipments of oil, medical supplies, and many other goods to Lithuania. In June—under pressure from Western nations—the Soviet Union and Lithuania held a series of talks that led to an agreement. Under the agreement, the Soviets restored shipments of raw materials and other goods to Lithuania. In turn, the Lithuanians agreed to suspend their declaration of independence temporarily, pending negotiations with the Soviet Union. However, in January 1991, Soviet forces moved into Lithuania to crack down on the independence movement. The forces killed 15 Lithuanians.

In 1991, the Soviet government recognized Lithuania's independence. In 1992, economic problems helped cause the Sąjūdis coalition to lose control of parliament. That year, the Democratic Labour Party—formerly the Communist Party—won a majority of the seats. In 1993, Algirdas Brazauskas became Lithuania's first president to be elected by the people.

See also **Kaunas; Klaipėda; Vilnius.**

Litmus is a substance that is commonly used in chemistry to indicate whether a solution is an acid or a base. It can be prepared in an acidic form, which is red, and in a basic form, which is blue. An acidic solution will turn blue litmus red, but will not affect red litmus. A basic solution will turn red litmus blue, but will not affect blue litmus. A neutral solution, which is neither acidic nor basic, will not change the colour of either litmus.

Litmus may be dissolved in water or alcohol to make an *indicating solution.* Because litmus is an intensely coloured substance, only a few drops of litmus indicator need to be added to a solution to tell whether it is acidic or basic. Litmus indicator is also used when a solution is being neutralized. For example, litmus indicator will turn an acidic solution red. In order to neutralize the acid, base is slowly added. When the solution becomes neutral, the litmus indicator will change to purple. If more base is added, the solution will become basic, and the litmus will turn blue.

Litmus may also be added to absorbent paper to make *litmus paper.* Litmus paper is blue or red, depending on which form of litmus is present. When a drop of solution is placed on the paper, the colour will indicate whether the solution is acidic, basic, or neutral.

Litmus is extracted from organisms called *lichens.* It was once used as a dye and in colouring beverages. Today, litmus is also used as a stain to make specimens easier to examine under a microscope.

See also **Acid; Base; Neutralization.**

Litre is a commonly used measure of capacity and volume in the metric system. The official unit for volume in the metric system is the cubic metre, but most people in countries using the metric system use the litre instead. In common usage, a litre equals a cubic decimetre, or 1,000 cubic centimetres.

See also **Weights and measures; Metric system.**

Little Bighorn, Battle of. See **Crazy Horse; Custer, George A.**

Little Lord Fauntleroy. See **Burnett, Frances H.**

Little Sisters of the Poor is a religious congregation of women in the Roman Catholic Church. It is dedicated to providing the aged poor with respectful care and attention until death. The congregation was founded in 1839 in St. Servan, France, by Jeanne Jugan. Today, the Little Sisters of the Poor have about 250 homes in 30 countries. The mother house is in St. Pern, near Rennes, France.

Littlewood, Joan (1915-), is a British theatre director and the founder of Theatre Workshop. Her notable productions include Brendan Behan's *The Quare Fellow* (1956) and *The Hostage* (1958) and the musicals *Fings Ain't Wot They Used T'Be* (1959) and *Oh, What a Lovely War* (1963). She also directed the film *Sparrers Can't Sing* (1963). Joan Littlewood came to believe that the theatre should bear a close relation to the hopes and thoughts of the people. She advocated that writers, actors, and producers should work closely together in creating drama.

Joan Littlewood was born in London and studied at the Royal Academy of Dramatic Art. She founded Theatre Workshop in 1945. She went to live and work in France in 1975.

Littoral zone rock platform is a platform of rock along the seashore. Such platforms are a common feature of the Australian and New Zealand coastlines.

Most platforms are large expanses of bedrock that have been eroded near sea level. They may be nearly horizontal or they may slope slightly seaward. They range in height, some remaining submerged even at low tide level, and others standing above water at high tide. Platforms are formed by the physical erosion of breaking waves and by the chemical erosion of seawater.

Liturgy is a term that refers to acts of worship that are performed by the members of a religious group. A liturgy is also called a *rite* or a *ritual.* Most religions have their own liturgy. But within a religion, various churches and denominations may develop their own kinds of liturgy.

A liturgy may combine words, music, and gestures. It also may include religious objects, such as altars and special clothing; and symbolic acts, such as pouring or sprinkling water as part of the ceremony of baptism. Some liturgical services are held at certain times of the day, week, or year. They may take place on a fast day, festival, or Sabbath.

The principal liturgical service in Christianity is called the Eucharist, Holy Communion, or the Mass. The Eastern churches call the Eucharist the Divine Liturgy. The most important events of the Christian liturgical year are Christmas and Easter. The most important annual services in the Jewish liturgy are Rosh Ha-Shanah and Yom Kippur.

Christianity has many forms of liturgy. The most widespread ones are the Byzantine rite and the Latin, or Roman, rite. The Byzantine rite is used by the Greek Orthodox Church and several other Eastern churches. The Latin rite is used by the Roman Catholic Church.

Today, most Western Christian liturgies are undergoing reform in both style and text. The reforms include a stronger emphasis on the Bible and more involvement of the congregation.

See also **Communion; Eastern Orthodox Churches** (Services); **Mass; Roman Catholic Church** (Worship and liturgy); **Sacrament.**

Liu Bang (248?-195 B.C.), also spelled *Liu Pang,* was a Chinese emperor who founded the Han dynasty. He is also known as Han Gaozu (Han Kao-tsu). He was the first commoner to become emperor. Liu reigned from 202 to 195 B.C. He revived feudalism in China by setting up regional kingdoms, with the rulers controlled by the central government. He was a skilful politician and made peace with tribes that were invading China from Mongolia. Although Liu was often cruel and ruthless, he eliminated many harsh laws. He was uneducated and generally scorned scholars.

Liu, a farmer's son, was born near Suzhou (Su-chou). He became one of the generals who led revolutionary forces against the Qin (Ch'in) dynasty from 207 to 206 B.C. The name Han Gaozu identifies Liu as "great ancestor" of the Han dynasty. See also **Han dynasty.**

Liu Pang. See **Liu Bang.**

Liu Shaoji. See **Liu Shaoqi.**

Liu Shaoqi (1900?-1969?), also spelled *Liu Shao-ch'i,* succeeded Mao Zedong as chairman of the People's Republic of China in 1959. Liu was also regarded as the future successor to Mao as head of the Chinese Communist Party. But during the Cultural Revolution of the late 1960's, he was accused of opposing Mao and expelled. In 1980—four years after Mao's death—China's Communist leaders denounced the earlier criticism of Liu and held a special service to honour him.

Liu was born in Hunan Province. Before the Communists won control of China in 1949, he worked as a labour organizer and underground agent.

Live-forever. See **Houseleek; Sedum.**

Live oak is a beautiful evergreen oak that grows along the southeastern coast of the United States. The tree grows about 15 metres high. Its horizontal limbs form a wide-spreading, dense head. The dark, glossy, oblong leaves may be 5 to 13 centimetres long. The live oak is a favourite tree for lawns and streets because it resists damage from storms, insects, and diseases. The wood is tough and was used extensively for shipbuilding.

Scientific classification. The live oak is a member of the beech family, Fagaceae. It is *Quercus virginiana.*

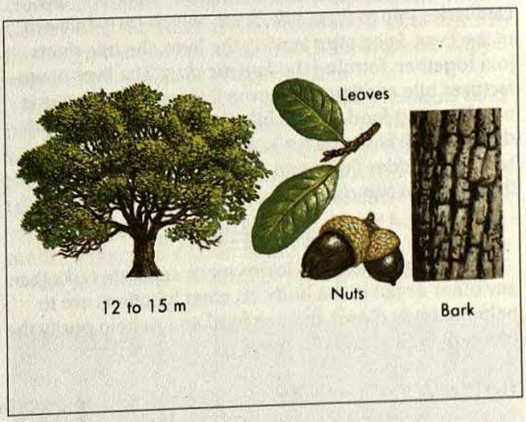
See also **Oak; Tree.**

Liver is the largest gland in the human body and one of the most complex of all human organs. The liver serves as the body's main chemical factory and one of its major storehouses of food. The liver is a reddish-brown mass weighing about 1.5 kilograms. It lies in the upper right part of the abdomen, directly under the diaphragm and above the stomach and intestines.

The liver performs many essential functions. One of its most important tasks is to help the body digest food. The liver produces and discharges *bile,* a greenish-yellow digestive fluid. Bile travels from the liver to the small intestine, where it aids in the digestion of fats. Extra bile is stored in the *gall bladder,* a pear-shaped pouch that lies under the liver.

The liver also stores food. Digested food travels in the blood from the small intestine to the liver. The liver removes some of the digested food from the blood and stores it. When the body needs food, the liver releases it into the blood. The liver also changes some digested food into compounds needed by the body's cells.

The live oak, *above,* is a beautiful evergreen oak. Its horizontal limbs form a wide-spreading, dense head. The tree has dark, glossy, oblong leaves, *below.* Its thick bark has a corklike texture. The tree grows throughout the Southeastern United States.



In addition, the liver filters poisons and wastes from the blood. Some substances produced by the liver help the body fight disease. Others enable the blood to clot.

The liver has a remarkable ability to produce new cells to replace its own diseased or damaged cells. For example, surgeons can remove a section of a healthy liver from an adult and transplant it into a child who has a diseased liver. The adult's liver will rapidly regenerate and be restored to full size. The child's new liver will grow as the child grows.

Structure of the liver

The liver consists of four sections, or *lobes.* There are two main lobes—the right lobe, which is by far the larger, and the left lobe. Two small lobes lie behind the right lobe.

Each lobe is made up of multisided units called *lob-*

ules. Most livers have between 50,000 and 100,000 lobules. Each lobule consists of a central vein surrounded by tiny liver cells grouped in sheets or bundles. These cells perform the work of the liver. Cavities known as *sinusoids* separate the groups of cells within a lobule. The sinusoids give the liver a spongy texture and enable it to hold large amounts of blood.

The liver has an unusual blood supply system. Like other organs, the liver receives blood containing oxygen from the heart. This blood enters the liver through the *hepatic artery.* The liver also receives blood filled with *nutrients,* or digested food particles, from the small intestine. This blood enters the liver through the *portal vein.* In the liver, the hepatic artery and the portal vein branch into a network of tiny blood vessels that empty into the sinusoids.

The liver cells absorb nutrients and oxygen from the blood as it flows through the sinusoids. They also filter out wastes and poisons. At the same time, they secrete sugar, vitamins, minerals, and other substances into the blood. The sinusoids drain into the central veins, which join to form the *hepatic vein.* Blood leaves the liver through the hepatic vein.

Each lobule also contains *bile capillaries,* tiny tubes that carry the bile secreted by the liver cells. The bile capillaries join to form *bile ducts,* which carry bile out of the liver. Soon after leaving the liver, the bile ducts join together, forming the *hepatic duct.* The liver manufactures bile continuously, even if the small intestine is not digesting food. Excess bile flows into the gall bladder, where it is stored for later use. Bile from the liver and gall bladder flows into the small intestine through the *common bile duct.*

Functions of the liver

The liver probably performs more separate tasks than any other organ in the body. Its chief functions are to help the body digest and use food and to help purify the blood of wastes and poisons.

Digestion and use of food. The secretion of bile ranks as one of the liver's most important digestive functions. Bile consists of bile salts and several other substances. The bile salts act on fats in the small intestine. They help break up globs of fat so enzymes in the intestine can convert fat molecules to fatty acids and glycerol.

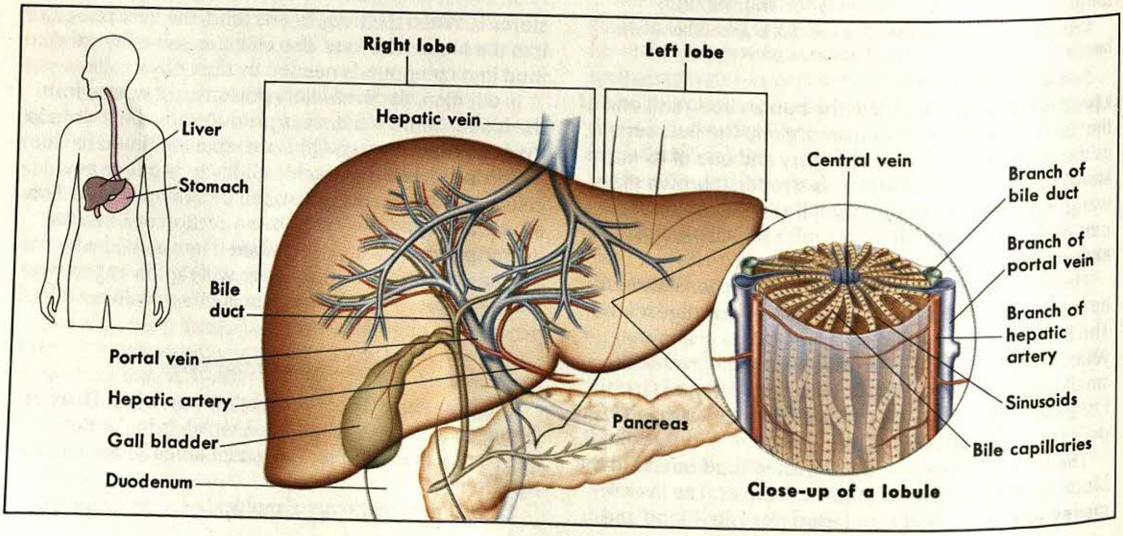
The liver also regulates the amount of certain nutrients that the cells of the body receive. Digestive enzymes in the intestine break down proteins into amino acids, and carbohydrates into simple sugars, primarily glucose. The blood carries these nutrients, as well as vitamins, minerals, and fatty acids and glycerol, to the liver. The liver removes the excess glucose from the blood and stores it in the form of a starchlike compound called *glycogen.* Glucose serves as the chief fuel for the body's cells. When the body needs energy, the liver converts glycogen to glucose and releases it into the blood. The liver also converts fatty acids and amino acids into glucose when its store of glycogen is low. In this way, the liver helps ensure that the cells of the body receive a constant supply of fuel.

The liver also plays an essential role in the storage of certain vitamins. The liver stores vitamin A, as well as vitamins D, E, and K, and those of the B-complex group. It also stores iron and other minerals.

Purification of the blood. Liver cells filter harmful substances from the blood. Such substances include insecticides, drugs, food additives, and industrial chemicals. Enzymes in the liver cells convert some of these substances into products that dissolve in water. The blood transports the substances to the kidneys, which discharge them in urine. Other harmful substances are excreted in the bile. The liver also filters many bacteria, viruses, and other microorganisms from the blood. Special liver cells surround these microorganisms and chemically digest them.

In addition, the liver filters out waste substances produced by the body. When red blood cells die, they release *haemoglobin,* the compound that enables them to

The liver The liver consists of two main sections—the right lobe and the left lobe—and two small lobes that lie behind the right lobe. Each lobe is made up of hexagonal-shaped units called *lobules.* The close-up section of the diagram below shows an enlarged view of a lobule.



carry oxygen. Cells in the liver and other organs break down haemoglobin into several substances, including iron and a reddish-yellow pigment called *bilirubin.* The liver discharges bilirubin in bile. It stores iron for use in producing new red blood cells.

The liver also rids the body of *ammonia,* a poisonous waste formed when amino acids are changed to other compounds in the liver. The liver converts the ammonia to *urea,* which is nonpoisonous. The urea is eventually discharged in urine.

Other functions. The liver manufactures various blood proteins, including *albumin, globulins,* and *fibrinogen.* Albumin helps to prevent *plasma* (the liquid portion of the blood) from seeping through the walls of the blood vessels. Globulins help the body fight infections. Fibrinogen enables the blood to seal broken blood vessels by forming a clot.

The liver also secretes *cholesterol,* a fatty substance. The body uses cholesterol to build cell membranes and to manufacture certain *hormones,* including the sex hormones. Hormones are chemicals that influence various body functions. Liver cells use cholesterol to manufacture bile salts.

Diseases of the liver

Because the liver performs so many vital jobs, liver diseases can have serious consequences. Death occurs if the liver stops functioning. Fortunately, the liver has a remarkable ability to produce new cells to replace diseased or damaged cells. In some cases of advanced liver disease, surgeons can replace a patient's failing liver with a healthy liver from a deceased donor.

Most liver diseases are painless in their early stages and therefore are difficult to detect. In many cases, one of the earliest signs of liver disease is *jaundice.* Jaundice occurs when the blood contains an excessive amount of bilirubin. This excess bilirubin causes a yellowish discoloration of the skin and the whites of the eyes. Jaundice may result if diseased liver cells fail to remove bilirubin from the blood. It also may occur if gallstones block the common bile duct, thus preventing the excretion of bilirubin in the bile. Jaundice does not always signal a liver disorder. Some cases result from an increased breakdown of red blood cells.

Hepatitis is an inflammation of the liver. Hepatitis may be caused by viruses or by toxins. There are five main types of viral hepatitis: hepatitis A, B, C, D, and E. They are spread in different ways and have different characteristics. For example, hepatitis A usually spreads through food and water that have been contaminated by human or animal waste. Most cases do not result in serious illness. Hepatitis B is transmitted by close contact with an infected person, or by exposure to infected blood. Severe cases of hepatitis B can lead to liver failure and death. A vaccine against hepatitis B is available.

Toxic hepatitis results from exposure to various chemicals. Such substances include carbon tetrachloride and other cleaning fluids, industrial chemicals, and certain medications. See **Hepatitis.**

Cirrhosis occurs when scar tissue replaces healthy liver cells. This process decreases the ability of the liver to perform its vital functions. Cirrhosis is a major cause of death in some countries. However, not all cases of cirrhosis result in death. Alcoholism is the most common cause of cirrhosis. Hepatitis can also cause cirrhosis. See **Cirrhosis.**

Other liver diseases. Because the liver filters disease-causing microorganisms from the blood, it frequently becomes infected when diseases strike other parts of the body. Such diseases as tuberculosis, amoebic dysentery, histoplasmosis, and syphilis can eventually affect the liver. Cancers from other parts of the body also often spread to the liver.

Related articles. See the Trans-Vision pictures with **Human body.** See also the following articles:

Bile
Gall bladder
Glycogen
Jaundice
Urea

Liverpool (pop. 448,300) is a city, port, and local government district in Merseyside, England, on the northern bank of the estuary of the River Mersey. It is one of the largest cities in England, and one of its busiest ports. Shipping has declined in Liverpool since the mid-1900's, but still forms the basis of the city's economy. Other important industries are car manufacturing, telecommunications, chemicals, pharmaceuticals, and food processing. For more information on Liverpool's economic and geographic importance, see **Merseyside.**

Liverpool has an impressive waterfront, which includes the Albert Dock, Maritime Museum, and Tate Gallery. The Pier Head on the riverbank is dominated by the twin towers of the Royal Liver Building, each capped with a huge replica of a mythical bird.

Passenger ships use the huge, floating Princess Landing Stage. Ferry boats provide regular services to Birkenhead, Seacombe (Wallasey), and New Brighton on the southern side of the river, while steamers sail to the Isle of Man and Dublin. Three tunnels also connect Liverpool with Birkenhead. Liverpool airport handles domestic flights and charter flights to mainland Europe.

Rail connections with other parts of Britain terminate

Liverpool's landmarks include the Royal Liver Building, *above.* The building is famous for its twin towers, each of which is topped by a sculpture of the mythical liver bird. The city is said to have been named after the liver bird.

at Exchange and Lime Street stations. Opposite Lime Street Station stands St. George's Hall, which accommodates the law courts and a large concert hall. Nearby stands the Walker Art Gallery, built in 1877. It houses one of the finest British collections of paintings outside London. The Merseyside County Museum and the City Libraries stand next to the gallery.

Liverpool University, founded in 1903, stands on high ground at Mount Pleasant, to the south of the city centre. The halls of residence are on Mossley Hill. Liverpool also has a polytechnic.

Near the university stands the new Roman Catholic cathedral. It has a unique conical shape and is visible from a great distance. Liverpool's Anglican cathedral was begun in 1904, but is still unfinished. Work continued on the building through World Wars I (1914-1918) and II (1939-1945). It was bombed in 1941. The cathedral was eventually opened by Queen Elizabeth II in 1978.

Liverpool's tallest building is St. John's Beacon, part of a spectacular shopping complex in the city centre. The Beacon is 137 metres high. Liverpool has one of the largest and most-varied shopping centres in Britain.

Many sporting facilities lie in or near Liverpool. The Grand National race is run on nearby Aintree racecourse. Aintree also has a motor-racing circuit. There are two football grounds, for Liverpool and Everton. Aigburth has a county cricket ground. The Waterloo Cup, one of the most important trophies in greyhound coursing, is competed for at Altcar.

Liverpool has many fine public parks and gardens. Princes Park is a pleasant area in the south of the city. The Botanic Gardens of Liverpool are noted for orchids. Speke Hall, near Liverpool airport, is a stately home dating from 1490.

Liverpool probably dates from Saxon times, although it is not mentioned in *Domesday Book.* It was a small fishing village when King John made it a borough and port in 1207. Liverpool grew in importance as a port, but its progress was slow. The first dock was opened at Liverpool in 1715. Ships based in Liverpool carried slaves from Africa to the West Indies and North America in exchange for various products. The city's importance greatly increased during the Industrial Revolution in the 1800's. The Liverpool and Manchester Railway, the first passenger railway in the world, opened in 1830. Britain's first transatlantic steamships operated from Liverpool.

Expansion continued in the 1900's. German air raids during World War II badly damaged Liverpool. But the city retained its importance with new developments in transport and industry.

Liverpool, Earl of (1770-1828), was Prime Minister of Britain from 1812 to 1827. Britain's war with Napoleon ended during Liverpool's ministry. Liverpool proved unpopular, partly because he maintained in peacetime many wartime measures that limited personal freedom. The Peterloo massacre occurred during his years in office. But Liverpool had great tact and calmness, good insight into people's characters, and wide experience of government.

Robert Banks Jenkinson was educated at Charterhouse and Oxford. He took a seat in the House of Commons in 1790 as a Tory, was made a peer in 1803, and succeeded his father as earl in 1808. From 1801, he held a series of high government offices.

Liverworts are small, leafy plants. They grow in damp, shady places, such as rotten logs and stream banks.

Liverwort is a type of small plant. There are more than 8,000 species of liverworts. Liverworts are found in polar, mild, and tropical regions. They contain chemicals called *terpenoids,* which give some liverworts a spicy aroma. Liverworts generally are inedible to people and many animals.

Botanists distinguish two general types of liverworts, *thalloid* and *leafy.* Thalloid liverworts consist only of a flat, leaflike *thallus* that grows horizontally along the ground. Leafy liverworts have three rows of leaves growing on a stem.

Liverworts do not have true roots. Instead, they are anchored to the ground by hairlike structures called *rhizoids.* A liverwort absorbs water over its entire surface and dries out quickly. Consequently, liverworts grow extremely close to the ground and often measure less than 1.5 centimetres high. Most liverworts grow only in damp, shady environments.

The life cycle of liverworts involves two distinct forms of the plant, the *sporophyte* and the *gametophyte.* The sporophyte consists of a small stalk with a podlike capsule that releases microscopic cells called *spores* into the air. The liverwort life cycle begins when a wind-blown spore lands in a suitable, moist location and develops into a gametophyte. The gametophyte is the form of the plant familiarly recognized as the liverwort. Most liverwort gametophytes develop one of two types of reproductive structures—spherical *antheridia* or flasklike *archegonia.* In some species of liverworts, the gametophyte bears both antheridia and archegonia. Each antheridium releases *sperm* (male sex cells), and each archegonium contains an *egg* (female sex cell). A sperm may swim to an archegonium and fertilize the egg. The fertilized egg eventually develops into a sporophyte, completing the life cycle.

Scientific classification. Liverworts make up the class Hepaticae. Liverworts, mosses, and hornworts make up the division Bryophyta.

See also **Bryophyte; Moss; Plant** (pictures: Liverworts and mosses).

Livery companies are institutions in the City of London that have evolved from medieval craft guilds. London has 84 livery companies.

Administration of charities. Today, the main function of the livery companies is to administer funds for charitable purposes. Each of the 12 largest companies has a large annual income. They use the money to care for old, sick, or needy people and to maintain schools and educational trusts. For example, the Grocers', Brewers', Tailors', Skinners', and Haberdashers' companies founded the schools of Oundle, Aldenham, Merchant Taylors, Skinners, and Haberdashers' Aske's. The Mercers' Company administers the trust funds for St. Paul's School. The Goldsmiths' Company endowed a chair of metallurgy at Cambridge University.

Control of trades and crafts. Today, many of the companies, such as the Fan-makers, Girdlers, and Horners, have lost all connection with the crafts they are named after. But other companies still have some control over their crafts. For example, the Gun-makers *prove* (test) the barrels of sporting guns. The Fishmongers inspect the quality of fish sold at Billingsgate market and help to prevent salmon poaching and the pollution of oyster beds. The company most closely connected with its craft is the Goldsmiths' Company. It still organizes the craft on medieval lines. It *assays* (tests) all articles of gold and silver produced in Britain to make sure that they contain the regulation amounts of precious metals.

Organization and membership. The constitution of a livery company generally provides for a court, composed of a master and wardens, to act as its main executive and administrative body. Officers of the court are elected from privileged members of the company, called *liverymen.* The liverymen are elected from the *freemen* (ordinary members) of the company.

The livery halls are the headquarters of the livery companies. The companies run their daily affairs from these beautiful halls. They also use them to hold their meetings and banquets. In the Middle Ages, boys were *bound apprentice* at the livery halls, and their names were inscribed in the apprenticeship registers kept there.

History. In the Middle Ages, members of the crafts formed guilds in order to keep a monopoly on their trade, to ensure high standards of craftsmanship, and to help and protect one another. They wore distinguishing *liveries* (robes).

See also **Guilds.**

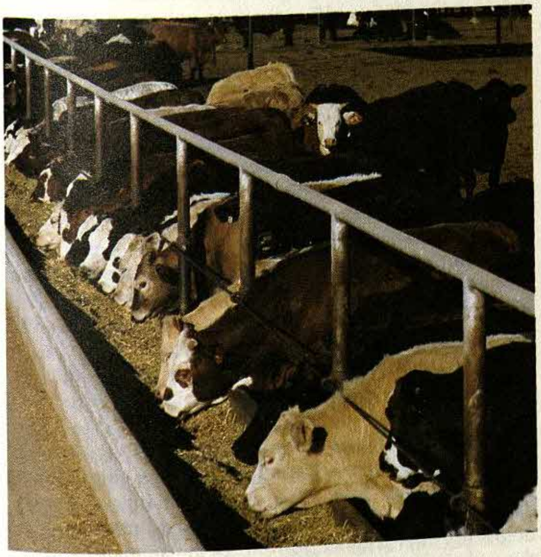
Livestock are domestic animals that are used to produce food and many other valuable products. The skins of some livestock provide such important materials as leather and wool. Various organs of livestock supply drugs used by countless people.

Farmers in developing nations use livestock to pull farm equipment. Some livestock in these countries also transport people and materials. Most livestock are reared on farms, but some people rear rabbits, chickens, or other small livestock at home.

The chief kinds of livestock reared throughout the world are cattle, pigs, poultry, sheep, and horses. Other kinds of livestock include donkeys, goats, mules, and rabbits. In some countries, farmers raise such livestock as llamas, reindeer, water buffalo, and yaks. The science of rearing, breeding, and caring for livestock is called *animal husbandry.*

At one time, people wandered from place to place hunting animals and gathering plants for food. Several thousand years ago, people began to domesticate various kinds of livestock. The use of domesticated animals as a source of food and power made it possible for people to settle in one place. They then were able to begin farming.

Throughout the centuries, farmers improved their livestock through various breeding methods. Today, many livestock breeders enter their animals in livestock shows, which are held in most parts of the world.



Modern methods of rearing livestock have increased production and efficiency. Many cattle receive special feed, *left,* that increases their growth rate. Some poultry houses, *right,* have equipment that automatically provides feed and water and collects eggs.

Livestock serve as work animals on farms in some countries. This Indonesian farmer is using a team of oxen to pull a plough.

Judges rate the livestock on such points as their size and their yield of meat.

This article provides general information on livestock. See also the separate *World Book* articles on the animals discussed.

Uses of livestock

In most parts of the world, livestock provide such food products as meat, butter, cheese, eggs, and milk. These foods contain large amounts of protein, which builds new tissue and maintains and repairs old tissue in the human body. Animal food products also supply minerals and vitamins that people need for good health.

Livestock also provide such valuable by-products as fur, hair, leather, and wool. These materials are used to produce blankets, brushes, clothing, shoes, and other goods. Manufacturers use the hoofs and horns of livestock to make such articles as buttons, combs, glue, and knives. Other livestock by-products are used in the preparation of livestock feed.

Some of the glands and organs of certain livestock are used to make such drugs as epinephrine, insulin, and pepsin. Processed animal fat, called *tallow,* can be made into livestock feed, shortening, and soap. Manufacturers use the feathers of ducks and geese in making bedding and insulated clothing.

Every year, livestock deposit tons of body wastes that fertilize the soil. This organic fertilizer increases the growth and food production of many plants.

Through the years, automated farm equipment has reduced the use of horses as work animals in most parts of the world. Today, people in developed nations use horses primarily for recreation and for racing and other sports.

Care of livestock

Feed. A domestic animal's daily food intake is called a *ration.* A balanced ration contains the nutrients that the animal needs for growth and good health. These nutrients include carbohydrates, fats, minerals, protein, and vitamins. Animals suffering from nutritional deficiencies produce less meat, milk, and eggs. They are also more likely to become unhealthy. Some livestock producers and animal feed companies use computers to determine the kind and proportion of ingredients used in livestock rations.

Swine and poultry feed consists of various grains, by-products from food-processing, minerals, vitamins, and concentrated plant and animal proteins. Cattle, sheep, and other *ruminants* (animals with more than one stomach compartment) eat the grasses of pastureland. They are also fed grain, hay, the stalks of certain plants, and other crop remains.

Many farmers rear cattle in fenced-in areas called *feed lots.* These animals receive special feed that increases their growth rate. The use of feed lots decreases the amount of land needed for grazing. It also concentrates the amount of animal wastes available for use as fertilizer. Farmers move these wastes from the feed lots to the fields to fertilize the crops.

Farmers feed additional cereal grains to some cattle to get a better quality of beef or a high level of milk production. When food shortages occurred in various countries during the mid-1970's, some farmers increased the amount of grass and hay fed to cattle. This feeding practice reduced the amount of grain used in animal feed and made more grain available for human consumption.

Drugs called *additives* are blended with some feeds to increase the animal's growth rate and reduce the chance of disease. These additives include antibiotics and synthetic hormones. The high cost of such drugs makes their use impractical in many countries. In many countries, the government controls the dosage and use of certain additives that might harm animal or human life. The governments of nations where additives are included in animal feed are becoming increasingly concerned about controlling the use of such drugs.

Farmers may use automated equipment to transport livestock feed to barns, elevators, and silos, where it is stored. Other equipment measures and mixes the ingredients in the feed.

Shelter. Livestock require some protection from severe weather so they can maintain satisfactory growth and reproduction. At one time, these animals could live easily without shelter. Through the years, however, farmers have developed breeding methods designed to increase meat production. These methods produce less hardy types of livestock. Today, many livestock cannot withstand extreme cold or heat. Exposure to snow and wind can also harm the animals.

Livestock owners provide the most economical type of shelter that can best maintain the animals' levels of food production. Some livestock need only a windbreak or shade tree for shelter. Others are sheltered in climate-controlled buildings where the humidity, light, sound level, temperature, and ventilation are precisely regulated.

Livestock kept in climate-controlled buildings are usually confined in small groups to reduce competition and fighting. The buildings are designed in such a way that the animal waste falls through cracks into pits below the floor. This design allows the animals to stay dry and clean. The waste is pumped from the pits and carried to the fields, where it is used as fertilizer.

Prevention of disease ranks as a major concern of livestock owners. Some diseases can kill large numbers of livestock or be transmitted to people. Sometimes, to prevent an epidemic, farmers must destroy all livestock that have come in contact with infected animals.

The chief causes of livestock diseases include bacteria, fungi, parasites, and viruses. Livestock also can become ill if they consume natural poisons or insecticides and other chemicals sprayed on grass and plants. Livestock inherit sensitivity to some diseases.

Many disease-carrying organisms that infect livestock are found in warm climates. Foot-and-mouth disease, tick fever, and other diseases severely limit livestock production in tropical countries.

Diseases spread extremely rapidly among pigs, poultry, and other livestock that are kept in confined areas. Young livestock also tend to become infected easily.

Scientists conduct many research programmes to find new ways of combating livestock diseases. These experts work to identify and eliminate the organisms that spread such diseases as swine fever and tuberculosis. Modern feeding methods have reduced the occurrence of some diseases.

Breeding livestock

Livestock breeders select certain animals for reproduction. Such livestock may be chosen because they have a high rate of growth or produce large amounts of meat, eggs, or milk. This practice, called *selective breeding,* allows farmers to continually improve their livestock. Farmers select only healthy and fertile animals for breeding purposes. Most of the offspring of such animals inherit the characteristics of their parents.

There are three chief methods of selective breeding: (1) random mating, (2) inbreeding, and (3) outbreeding.

Random mating is the simplest type of livestock breeding. Livestock producers place selected males and females of one species in the same area and allow them to mate at random.

Farmers practise inbreeding by mating animals that are closely related to each other. This method produces a pure breed of livestock. Livestock owners select animals for inbreeding by studying their *pedigrees,* which list the traits of an animal's ancestors. Livestock that are closely related have similar genes, which are transmitted to their offspring. These offspring may have a high concentration of the parents' favourable genes. However, inferior genes, which were not visible in the parents, may show up strongly in the young. Therefore, inbreeding may produce a small animal that lacks resistance to disease.

Outbreeding is the mating of unrelated animals. *Outcrossing* and *crossbreeding* are two methods of outbreeding often used by farmers. Outcrossing is the mating of unrelated animals of the same breed in order to introduce a desirable trait into a line of livestock. Crossbreeding is the mating of animals of different breeds. Most of the offspring have a higher performance level than the average performance level of the parents.

Many breeders use artificial insemination to improve the quality of their livestock. Diluted *semen* (sperm-carrying fluid) from a high-quality male is injected into the reproductive tract of the female at the proper time for fertilization. This increases the number of offspring that can be produced by superior male animals.

Related articles in ***World Book*** include:

Chief kinds of livestock

Cattle
Chicken
Duck
Horse
Pig
Poultry
Rabbit
Sheep
Turkey

Other related articles

Agriculture
Animal husbandry
Breeding
Dairying (Dairy farms)
Environmental pollution (Economic causes)
Farm and farming (with pictures)
Feed
Veterinary medicine

Living standard. See **Standard of living.**

Living things. See **Biology; Cell; Life.**

Living will is a document that states the kind of medical care an individual would prefer if, due to injury or disease, the person could not communicate his or her wishes. It also may name treatments the person would not want if they were near death or in a coma from which they could never recover. Advances in medical science have enabled doctors to keep some patients alive by artificial means. Living wills are useful because, unless told otherwise, many doctors assume their patients want to be kept alive as long as possible. The document is called a *living will* because it becomes effective while the person is still alive. A living will is not, however, a legal document and is not recognized in many countries.

Livingstone, David. See **Stanley and Livingstone.**

Livorno. See **Leghorn.**

Livy (59 B.C.-A.D. 17) was one of the greatest Roman historians. His *Historiae ab Urbe Condita (History from the Founding of the City)* tells of Roman history from the founding of Rome until the death of Drusus in 9 B.C. The work also gives valuable information about the social, cultural, and political attitudes of Romans during the reign of Emperor Augustus (27 B.C.-A.D. 14). Livy wrote the work in 142 books, but only 35 of them survive.

Livy spent more than 40 years working on his history, which became famous in ancient times and was widely quoted. The lengthy work became known chiefly through short summaries or abridgements. Many of these summaries have survived.

Livy was born in Padua in northern Italy and lived in Rome during the reign of Emperor Augustus. He was a friend of the emperor, but he carefully guarded his independence as a historian.

Lizard is a reptile closely related to snakes. Like snakes, some lizards are legless. Others resemble snakes but have legs. Many large lizards look much like crocodiles. Lizards vary in size, shape, and colour. They have many different ways of moving about and of defending themselves. Scientists have identified more than 3,750 different *species* (kinds) of lizards. Australia has over 500 species.

Where lizards live. Lizards lack the built-in body temperature control many other animals have. So, most lizards live in places where the ground never freezes. Those that live in areas with cold winters must hibernate. Lizards thrive in the tropics and warm parts of the temperate zones. They are the most common reptiles found in deserts and other dry regions. When the desert becomes too hot for comfort, lizards lie in the shade or under the sand to escape the sun's rays.

The Nile monitor of Africa grows to about 2 metres long. It digs, runs, and swims well, and can climb trees. This lizard spends much time in water and feeds on many kinds of smaller animals.

Sizes of lizards. The smallest lizards are only a few centimetres in length. The largest lizard is the *Komodo dragon.* This huge East Indian lizard grows to more than 3 metres long and may weigh up to 150 kilograms. The Komodo dragon belongs to a group of lizards known as *monitors.* Some other monitors grow to more than 2 metres in length. These lizards live in Africa, India, and Australia.

How lizards move. The most remarkable thing about lizards is the variety of ways by which they move. More than 60 million years ago, huge lizards called *mosasaurs* swam in the sea. Even today, giant monitors sometimes swim from one island to another. No present-day lizard can fly, but a small group in Asia and the East Indies glide from tree to tree like flying squirrels. These lizards are the so-called *flying dragons.* They can spread out a fold of skin along either side of their body by moving several long ribs. This extended fold of skin forms a sort of sail that is used to glide through the air.

Most lizards, however, live on the ground or in trees. Even on the ground, the lizards have many different ways of moving about. Some *geckos,* lizards that spend much time in trees, have claws that they can draw in as a cat does. Some have slits on their toes that function like suction discs. The claws catch in rough surfaces such as bark, and the slits cling to smoother ones. A gecko can walk upside down across a plaster ceiling without trouble, and can even cling to a pane of glass. The Australian *fringed lizard,* and the *basilisk* of tropical America can run by raising the front of the body and running on their hind legs.

Snake lizards are found only on mainland Australia and New Guinea. All lay eggs.

Many lizards that live on the ground can get along without any legs. Some *skinks,* for example, have no legs. Other skinks have weak, nearly useless legs. The European *blindworm* or *slowworm,* North American *glass snake* and some of the Australian *snake lizards* are all lizards without legs. They have well-developed eyelids and ear openings, which are absent in snakes.

Defences. Lizards defend themselves in a great variety of ways. Like some snakes, many lizards bluff or play tricks. Many lizards can shed their tail if attacked. The tail keeps twitching long afterwards to distract the predator, and allows the lizard time to get away.

Other common ways of bluffing include swelling up, hissing, and lashing the tail. The Australian *frilled lizard* ranks as one of the best bluffers. This lizard rears on its hind legs, spreads an enormous frill out on each side of its neck, opens its mouth, and hisses. These antics make the frilled lizard look several times as big and fierce as it really is. A large frilled lizard measures about 80 centimetres long.

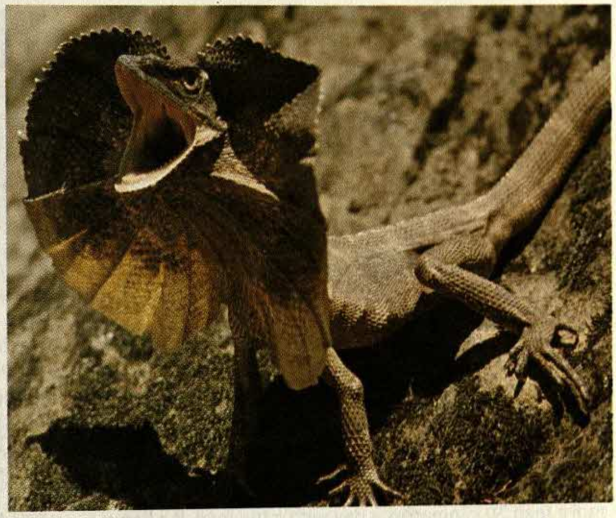
The Australian blue-tongued skink exposes its large, bright blue tongue to scare off predators.

Some lizards are not such harmless fighters. The monitors and their relatives use their large jaws for biting. They also use their tails as whips to strike a sharp blow. Unlike snakes, few lizards are poisonous. The only poisonous lizards are the *Gila monster* of the Southwestern United States and northern Mexico, and its close relative, the *beaded lizard* of Mexico.

The *horned lizards* of desert regions have an unusual ability. They can squirt a thin stream of blood from their eyes for a distance of nearly 1 metre. They use this trick when an enemy attacks them. Sharp spines on their head and back provide added protection. Many people call these lizards *horned toads* because their body has a flattened, toadlike shape.

The *African chameleons* are famous for the way they can change colour. Many other lizards have the same power. Many people think that these changes help the

The collared lizard is named after the black bands around its neck. It lives mainly in rocky areas of the Southwestern United States.



The Australian frilled lizard frightens enemies away by opening its mouth with a hiss and unfolding the large frill that encircles its head. The frill of an adult male may have a diameter of 23 centimetres.

animal to protect itself, but they are not always used in this way. Sometimes, these lizards turn a darker colour to absorb more heat from the sun's rays. Some lizards do rely on their colours for protection. Many desert lizards are light in hue, and those that dwell in the forest are darker. The different species have various combinations of green, red, grey, brown, white, and black.

Reproduction. Male anole lizards of the American tropics, attract the females by bobbing their head up and down and at the same time, exposing the brightly coloured *dewlap* (loose flap of skin under the chin). Geckos and monitor lizards rely more on a well-developed sense of smell to attract their partners. When the females are ready to mate, they secrete certain *hormones* (chemical messengers) that are detected by the males. Most lizards lay eggs. Some deposit them in simple nests. The female skink may coil around the eggs and drive away any intruders. If the eggs become scattered, she brings them back together.

Some lizards do not lay their eggs but give birth to living young after the eggs hatch inside the lizard's body. Still other lizards reproduce in somewhat the same way as mammals. These lizards also give birth to living young. Before birth, the developing lizard gets food from the mother lizard's body. Unlike female mammals, the female lizard does not nurse her young or care for them after birth.

Some species of North American *whiptails* and European *lacertid lizards* have only female individuals. The adult females lay unfertilized eggs that hatch only into females. This kind of reproduction behaviour is known as *parthenogenesis* (virgin birth). It is more common among insects.

Food. Lizards have less interesting eating habits than snakes. But, unlike snakes, some eat plants instead of animals. The *marine iguanas* of the Galapagos Islands feed on algae. They gather the plants off the rocks at low tide. Hundreds of species of lizards eat mostly insects and small animals. Most do not limit their diet to any one thing. Some Australian skinks live on a mixed animal and plant diet of snails, worms, and plant seeds. A few lizards, such as African chameleons, have a tongue that they can shoot out beyond their snout. They capture insects on their tongue's mucus-coated tip. Other lizards seize their victims in their mouths. They swallow their prey as soon as it stops struggling.

Dangers to lizards. Human activities threaten the survival of certain species of lizards. People gather lizard eggs and hunt iguanas and other lizards for food in some countries. In many areas, the animal's habitats have been destroyed. In the past, some lizards were killed for their skins, which were used to make wallets, handbags, and other products. But many countries now forbid killing lizards for this purpose.

Scientific classification. Lizards belong to the class Reptilia. They are members of the order Squamata, along with snakes. Lizards alone make up the suborder Sauria (Lacertilia). There are about 16 families of lizards; the largest is the family Scincidae, with over 1,200 species.

Related articles in *World Book* include:

Animal (picture: Animals of the tropical forests)
Blindworm
Brain (picture: Some animal brains)
Chameleon
Chuckwalla
Flying dragon
Gecko
Gila monster
Glass lizard
Horned lizard
Iguana
Komodo dragon
Monitor
Prehistoric animal
Reptile
Skink
Swift
Tegu

Ljubljana (pop. 276,133) is the capital and largest city of Slovenia. It is located in the central part of the country (see **Slovenia** [map]).

Ljubljana is the cultural centre of Slovenia. It is the home of the University of Ljubljana and several museums. The museums include the National Museum, the Slovenian Natural History Museum, and the Ethnographic Museum. The chief products manufactured in Ljubljana include electronics, machinery, paper products, and textiles.

The first settlements in the Ljubljana area date from about 3000 B.C. Ljubljana was under Austrian control during most of the period from A.D. 1276 to 1918. The city had become an important wine-producing centre by the 1700's. In 1918, it was made capital of Slovenia, a part of a country called the Kingdom of the Serbs, Croats, and Slovenes. This country was renamed Yugoslavia in 1929. Slovenia declared independence from Yugoslavia in 1991, and Ljubljana became its capital.

Llama is the largest South American member of the camel family. The llama, like its smaller relative, the *alpaca,* is a domesticated animal that is descended from the *guanaco.* The *vicuña* is the llama's only other wild relative.

The llama has no hump, and is about 1.2 metres tall at the shoulder. Its thick, long hair may be brown, buff, grey, white, or black. The female llama bears one young at a time.

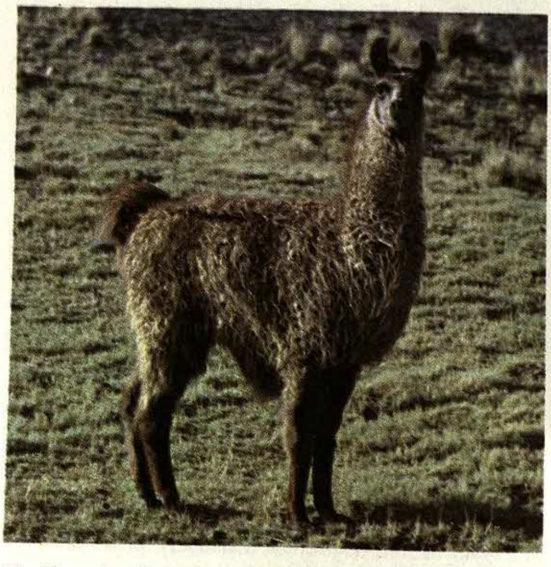
The llama is most useful as a pack animal. Llamas generally can carry up to about 60 kilograms each, and are sure-footed on the mountain trails. They can travel for more than 30 kilometres a day with a full load. If a llama feels overloaded or tired, it will lie down and refuse to move. When the llama is angry or under attack, it spits bad-smelling saliva in its enemy's face.

The llama is useful to the Indians of the South American Andes. When the Spanish conquerors came to this area during the 1500's, about 300,000 llamas were being used to carry silver from the mines. The Indians still use llamas to transport goods. They eat the meat of the young animals. They use the hair of the llama to make garments, and they use its hide to make sandals. The llama is inexpensive to keep. It is hardy and eats grasses and low shrubs that grow on high mountains. The llama does not need to drink a great deal of water. It can get much of its moisture from plants.

Scientific classification. The llama ia a member of the camel family, Camelidae. It is *Lama glama.*

See also **Alpaca; Camel; Guanaco; Ruminant; Vicuña.**

Llandudno. See **Aberconwy** and **Gwynedd.**



The llama has thick hair and a long neck and looks somewhat like a small camel. But unlike camels, llamas have no hump.

Llanelli (pop. 73,500) is a local government district in the Welsh county of Dyfed. It includes the towns of Llanelli and Kidwelly and the port of Burry Port. Farmers grow cereals and root crops. The towns have engineering, steel production, and the mining of anthracite coal. Industrial products include car bodies, chemicals, textiles, and copper wires for cables. Llanelli dates from the A.D. 1000's. Kidwelly has a castle that was built in the 1200's.

See also **Dyfed.**

Llanfairpwllgwyngyll is a village on the island of Anglesey, in Gwynedd, Wales. As a hoax, in the early 1800's, the village's name was lengthened to *Llanfairpwllgwyngyllgogerychwyrndrobwllllantysiliogogogoch.* The village often used the long name, which was the longest place name in the United Kingdom. In 1988, the village council officially returned to the shorter name. The word *Llan* means *church* in Welsh. *Fair,* which was originally spelled *Mair,* is the name for the Virgin Mary. *Pwllgwyngyll,* which means *hollow of white hazel,* was the name of the medieval township in which the church of the name *Llanfair* stood. The entire long name of the village means *Church of St. Mary in a hollow of white hazel, near a rapid whirlpool, and St. Tysilio's Church of the red cave.*

Llanos, meaning *level lands,* is most often used to mean a great *savanna* (grassland with scattered trees) region in Venezuela and Colombia. This plain is known as the Orinoco Basin. The region covers about 780,000 square kilometres. Farmers have traditionally raised cattle and horses on the llanos. But the region has wet and dry seasons that make farming difficult. During the 1960's, government officials began flood control and irrigation programmes to increase its agricultural production. A major industrial facility is located at Ciudad Guayana, Venezuela, on the llanos. The facility uses iron ore and bauxite from nearby mines. It receives energy from a hydroelectric plant on the Orinoco River.

See also **Pampa; Savanna.**

Lliw Valley (pop. 61,700) is a local government district in West Glamorgan, Wales. It includes the towns of Gorseinon, Loughor, Pontardawe, and Pontardulais. The administrative offices are at Penllergaer, near Swansea. Industries in the Gorseinon area produce such things as abrasives, adhesive tapes, and video tapes. Industries at Pontardawe produce engineering goods, hosiery, and refrigeration equipment.

See also **Glamorgan.**

Lloyd, Clive (1944-   ), captained the West Indies cricket team 74 times, achieving 36 victories. Both these feats are test records. The West Indies, under his leadership, became the most powerful test cricket team in the world.

Lloyd, a tall, aggressive, bespectacled left-handed batsman, was also a medium-pace, right-arm bowler and a superb fielder. Lloyd first played for British Guiana (now Guyana) in 1963 and for Lancashire from 1968, becoming captain of that county in 1981. He began his test career in India in 1966. Altogether, he played in 110 tests, and scored 7,515 runs. He scored 19 test centuries, with a highest score of 242 not out. Lloyd also led the West Indies to two World Cup victories. He gave up test cricket in 1985 and first-class cricket a year later. Clive Hubert Lloyd was born in Georgetown, Guyana.

Harold Lloyd

Lloyd, Harold Clayton (1894-1971), was an American comedian who won fame in silent films. He created and acted the role of "Harold." The character was a small-town boy who overcomes comic adversity to achieve success and impress his girlfriend in the big-city business world of the 1920's. Lloyd made a speciality of adventures on tall buildings. He appeared in a famous scene hanging from a clock atop an office building in *Safety Last* (1923). Lloyd's other silent comedy features include *Grandma's Boy* (1922), *The Freshman* (1925), and *The Kid Brother* (1927). Lloyd also made several sound comedies. Lloyd was born in Burchard, Nebraska. He began his screen acting career in 1915.

Marie Lloyd

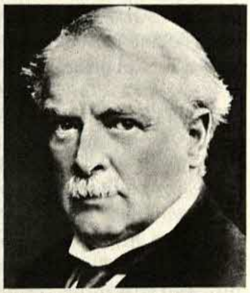
Lloyd, Marie (1870-1922), was a popular music-hall performer in London in the early 1900's. She was known as the *Queen of Comediennes.* She had an endearing personality and was greatly loved by audiences. She had a broad cockney wit, and she gained a reputation for sauciness for the way in which she performed such songs as "What's That For, Eh?" and "She'd Never Had Her Ticket Punched Before." Her best-known songs included "Oh, Mr. Porter" and "The Boy I Love Is up in the Gallery." Marie Lloyd was born Matilda Alice Victoria Wood in north London.

Lloyd George, David (1863-1945), a British Liberal Party leader, was prime minister during the last half of World War I (1914-1918). He was also prominent in helping to draft the Treaty of Versailles that ended the war. He was active in British politics until his death.

Early career. Lloyd George was born of Welsh parents in Manchester, England. His father died when he was a year old. His mother took him to Llanystumdwy in Caernarvonshire (now Gwynedd), Wales. There he grew up in the home of his uncle, Richard Lloyd, a shoemaker and a Baptist minister. He was reared in an atmosphere of hostility to the landed aristocracy and the Church of England. He was apprenticed to a law firm at 16 and began to practise law at 21.

Lloyd George early associated himself with the Liberal Party. In 1890, on a platform of comprehensive social reform for Wales, he was elected to Parliament from the Caernarvon Boroughs, which he represented continuously for 55 years. As a "radical" he became widely known through his attacks on the government's policy in South Africa before and during the Boer War.

When the Liberals returned to power in 1905, Lloyd George became president of the Board of Trade. From 1908 to 1915, he served as chancellor of the exchequer. He sponsored the Old Age Pension Act of 1908 and the National Insurance Act of 1911. His "People's Budget" of 1909 introduced a tax on "unearned income" and greatly increased land and inheritance taxes. The Conservative House of Lords rejected this budget. This caused a constitutional crisis which ended in victory for Lloyd George and his party. The power to veto financial legislation was taken away from the House of Lords.



David Lloyd George

Prime minister. The coming of war in 1914 changed Lloyd George from a pacifist to a staunch supporter of the war against Germany. As minister of munitions in 1915, he ended shortages in ammunition. In July 1916, he succeeded Lord Horatio Kitchener as secretary of war, and in December 1916, he replaced Herbert Asquith as prime minister of a coalition cabinet. Lloyd George is recognized as one of the United Kingdom's great war leaders. His leadership strengthened civilian morale. At the Paris Peace Conference in 1919, he mediated successfully between the idealism of U.S. President Woodrow Wilson and the severe peace terms sought by Premier Georges Clemenceau of France.

An easy electoral victory in December 1918 kept Lloyd George and his coalition government in office. But he did not achieve the economic reconstruction he had promised. His Irish policy led to the formation of the Irish Free State, but cost him Conservative support. His pro-Greek policy failed. He resigned in 1922. Though only 59 years old, he never again held office. The Liberal Party, divided in 1918 between his supporters and those of Lord Asquith, was reunited in 1923 but lacked popular support. It soon became a weak third party.

Lloyd George tried unsuccessfully to make a comeback with an elaborate programme of public works and agricultural reform. He visited Adolf Hitler at Berchtesgaden in 1936 and returned with praise for the German leader. But he soon became a severe critic of appeasement of Hitler. In 1945, shortly before his death, he was created Earl of Dwyfor.

Lloyd Webber, Andrew (1948-), a British composer, won fame for his rock musical *Jesus Christ, Superstar!* (1970), written to words by Tim Rice (see **Rice, Tim**). Lloyd Webber and Rice also collaborated on other musicals, including *Joseph and the Amazing Technicolour Dreamcoat* (1968) and *Evita!* (staged in 1978). These works helped create renewed interest in British musicals. Lloyd Webber also composed the music for the musicals *Cats* (1981), *Song and Dance* (1982), *Starlight Express* (1983), *Phantom of the Opera* (1986), *Aspects of Love* (1989), and *Sunset Boulevard* (1993).

Lloyd Webber was born in London into a musical family. His father, William Lloyd Webber (1914-1982), became director of the London College of Music in 1964. His brother, Julian Lloyd Webber (1951-), is a brilliant cellist.

In addition to his stage work, Lloyd Webber wrote film scores for *Gumshoe* and *The Odessa File.* In 1977, he wrote *Variations* (on Paganini's violin Caprice No. 24) for cello and rock band.

Lloyd's is an insurance association in England popularly known as *Lloyd's of London.* It consists of individual members known as *Lloyd's underwriters.* The society is famous for insuring almost any risk. Lloyd's pioneered many forms of insurance that have since become commonplace, such as burglary, loss of profits, hurricane, and earthquake insurance. The society does not sell life insurance, except on a short-term basis.

Today, Lloyd's has about 19,500 underwriters grouped into about 228 *syndicates* (combinations). These syndicates vary in size from a few people to several hundred people.

In 1993, Lloyd's confirmed record losses for their 1990 accounting year of nearly 3 billion pounds. As part of a reorganization to generate more capital, Lloyd's announced that from 1994 it will admit corporate membership, moving away from exclusively individual membership.

Lloyd's provides its members with worldwide merchant shipping reports. This information is published daily in *Lloyd's List and Shipping Gazette.* Founded in 1734, it is the oldest newspaper in London.

Lloyd's originated in the coffee house of Edward Lloyd in about 1690. The coffee house was a favourite meeting place for ship owners and wealthy merchants who would *underwrite* (accept the risk of) a marine insurance policy. In the 1900's, Lloyd's partly or completely insured property lost in the San Francisco earthquake and fire in 1906, the sinking of the *Titanic* in 1912, the airship *Hindenburg,* which burned in 1937, and many disasters in the oil industry.

See also **A 1; Insurance; Underwriting.**

Loach is any of approximately 175 species of small, slender, freshwater fish. Loaches live in mountain streams, lakes, and swamps in Europe, Asia, and northern Africa. Many loaches are flat on the underside, which allows them to lie on the bottom of fast-moving streams. Other loaches have a rounder, more wormlike body. The mouth is on the underside of the head and is surrounded by fleshy whiskers called *barbels.*

Most loaches are about 10 to 15 centimetres long. However, a species of loach called the European *weatherfish* can reach more than 50 centimetres in length. Some loaches, such as the *clown loach,* are colourful and popular aquarium fishes. Many loaches are delicious to eat.

Scientific classification. Loaches belong to the family Cobitidae. The scientific name for the weatherfish is *Misgurnus fossilis.*

See **Fish** (Fish of tropical fresh waters [picture]).

Loadstone. See **Lodestone; Magnetism** (picture).

Loam is a soil that is between sandy soil and clay soil in texture. Loams are chiefly mixtures of sand, clay, and silt. They are among the most valuable soils in agriculture, and are easy to work. A typical loam soil feels smooth and is somewhat sticky. A piece of clay feels very smooth and sticky. Any soil between loam and clay in texture is called a *clay loam.* Soil between sand and loam is called *sandy loam. Silt loam* contains much silt.

See also **Clay; Humus; Sand; Soil.**

Loan. See **Bank** (Making loans); **Bond; Insurance** (Life insurance).

Lobelia is the name of about 350 species of flowers sometimes cultivated as ornamental plants.

Loan-sharking. See **Crime** (Organized crime).

Lobbying is an attempt to influence the decisions of government officials. People who try to persuade legislators to vote in a particular way are known as *lobbyists.* The words refer to the lobby or anteroom outside the room where legislators vote on public bills. Lobbyists also frequently try to influence the decisions of officials in the executive branch. The lobbyist may belong to a group interested in a particular law or be a paid agent of a group that wants certain bills passed or defeated.

See also **Propaganda** (Organizations).

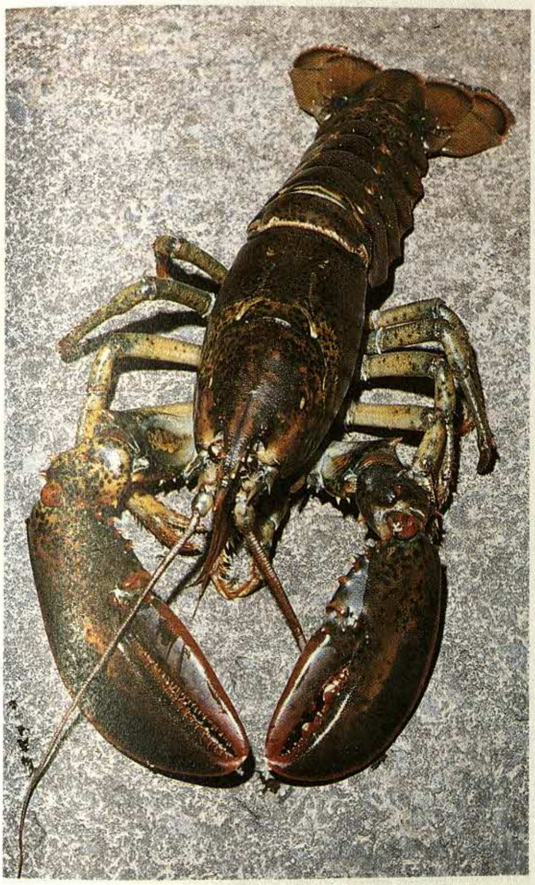
Lobelia, native to South Africa, is a low-growing perennial plant usually grown as an annual. It has blue or pink coloured flowers. It is most often used as an edge plant to flower borders, in window boxes, and a trailing form is popular in hanging baskets. The cardinal flower, a type of lobelia from North America, has scarlet flowers. See **Cardinal flower.**

There are some giant lobelias that grow on mountains in Africa, at altitudes of over 4,500 metres. The largest giant lobelia grows to 9 metres tall.

Scientific classification. Lobelias belong to the bellflower family, Campanulaceae. The bedding lobelia is *Lobelia erinus,* the cardinal flower is *L. cardinalis.*

Lobster is a hard-shelled animal that lives on the bottom of the ocean near the shore. A stiff shell covers the lobster's entire body like a suit of armour. The animal has two large claws that reach out in front and are almost as long as its body. The lobster's tail spreads out behind like a fan. Most kinds of lobsters have dark green or dark blue shells with spots on them. The shells turn bright red when the lobsters are cooked.

The tasty meat of the lobster makes it a favourite seafood. Lobsters are found in both the Atlantic and Pacific oceans. But the best lobster meat comes from lobsters of the north Atlantic Ocean.



A true lobster, *above,* has thick legs and huge front claws. It uses its claws to kill and handle prey. Lobsters eat crabs, snails, small fish, and other lobsters.

The thick muscles of the tail and claws of *true lobsters,* and mainly the abdomen muscles of *rock* or *spiny lobsters* are eaten. Large lobsters can weigh up to 20 kilograms.

Lobsters have no backbone. They belong to a group of animals called *crustaceans.* The word *crustacean* comes from a Latin word meaning *hard shell.* Other crustaceans include crabs, crayfish, and shrimp.

The body of a lobster

The common lobster of the continent of North America, which is usually called the American lobster, measures 30 to 60 centimetres long and weighs 0.5 to 1 kilogram. Most European lobsters are smaller than American lobsters.

The lobster's body has 19 parts. The head has five parts, the *thorax* (centre part) has eight, and the abdomen has six. Each part is covered by a section of the shell. The shell is thin and soft where the parts join, so the lobster can bend its body and move about. The lobster breathes through gills located beneath the shell on both sides of its thorax.

A lobster has two pairs of antennae on its head. The animal's eyes are on the ends of a pair of slender, jointed organs called *stalks.* Lobsters have *compound* eyes that consist of hundreds of lenses joined together. The lobster keeps its antennae and eye stalks moving constantly to search for food and to watch for enemies. The lobster's antennae, legs, and shell are covered with millions of tiny hairlike sensors that can detect chemicals. The sensors help the animal locate food.

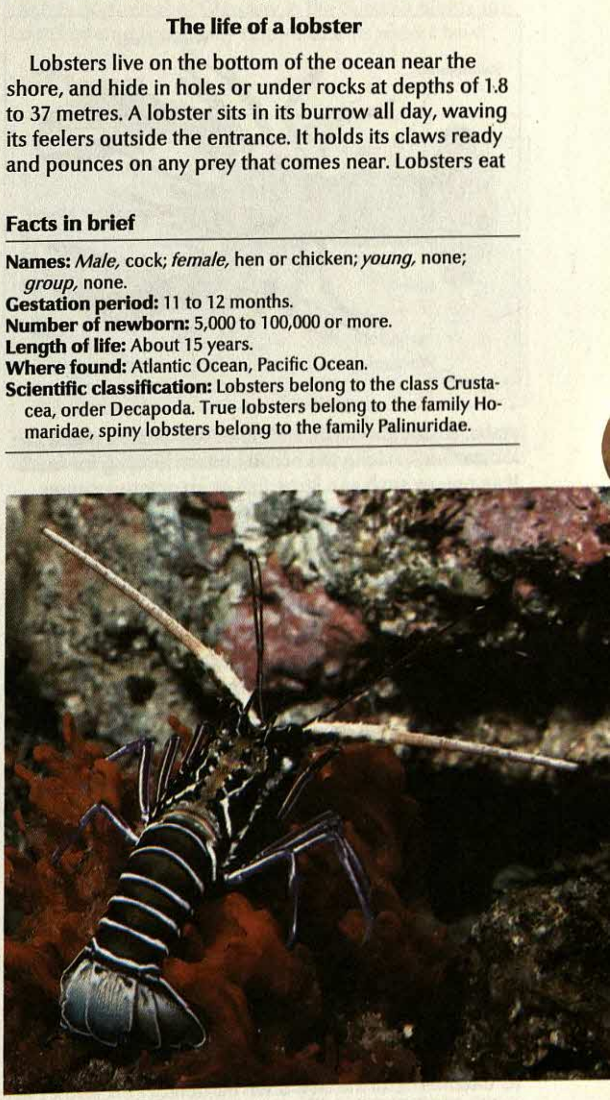
A lobster has five pairs of jointed legs. Four pairs are thin, and the lobster uses them for walking. In true lobsters the fifth pair, which extend in front of the head, are thick and end in large claws. One of the claws is heavy and has thick teeth to crush prey. The other claw is smaller and has sharp teeth to tear food apart. All lobsters do not have the heavy claw on the same side. Some are "right-handed," and others are "left-handed." The front claws of spiny lobsters are long and slender. This lobster, named after the sharp spines on its shell, lives in coastal waters throughout much of the world.

The life of a lobster

Lobsters live on the bottom of the ocean near the shore, and hide in holes or under rocks at depths of 1.8 to 37 metres. A lobster sits in its burrow all day, waving its feelers outside the entrance. It holds its claws ready and pounces on any prey that comes near. Lobsters eat

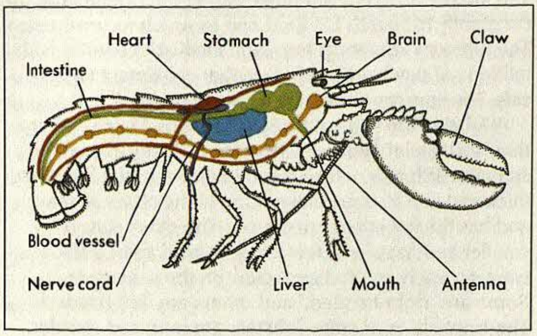
Facts in brief

Names: *Male,* cock; *female,* hen or chicken; *young,* none; *group,* none.
Gestation period: 11 to 12 months.
Number of newborn: 5,000 to 100,000 or more.
Length of life: About 15 years.
Where found: Atlantic Ocean, Pacific Ocean.
Scientific classification: Lobsters belong to the class Crustacea, order Decapoda. True lobsters belong to the family Homaridae, spiny lobsters belong to the family Palinuridae.

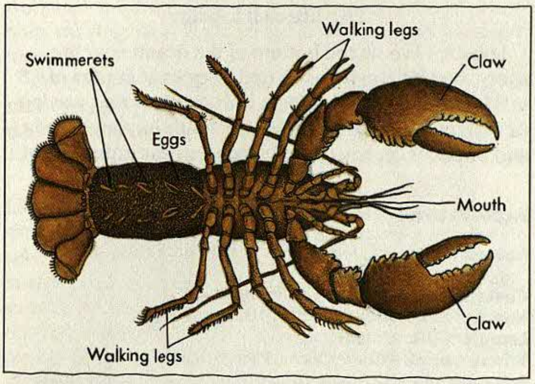


A spiny lobster, *above,* has slender legs and claws. This kind of lobster was named after the sharp spines on its shell. Spiny lobsters live in coastal waters throughout much of the world.

The body of a lobster



Underside of a female lobster



crabs, snails, small fish, and other lobsters. At night, the lobster walks along the ocean bottom looking for food. If an enemy such as a large fish or an octopus comes near, the lobster retreats into its burrow with powerful flips of its tail.

Young. A female lobster usually lays eggs only once every two years. She may lay 5,000 to 100,000 or more eggs at a time. The number varies with her size and age. The female lobster carries the eggs under the curve of her tail for 11 to 12 months. When the eggs are ready to hatch, the lobster shakes the young out of the eggshells. Newborn lobsters are about 8 millimetres long. They rise to the surface, and drift and swim about for three to five weeks. At this time, they are easy prey for sea birds, fish, and other enemies. Then the lobsters sink to the ocean bottom where they spend the rest of their lives. Lobsters live for about 15 years.

Growth. Lobsters *moult* (cast off their shells) as they grow. The animal loses its first shell two days after hatching, and moults three more times during the first month. When moulting, the lobster's body gives off a substance that softens the shell. Then, by expanding its muscles, the lobster splits the shell and steps out of it. This whole process takes about 15 minutes. The new shell, which had formed under the old one, is soft and gives the lobster no protection. The animal hides from its enemies until the new shell hardens.

See also **Crustacean.**

Lobworm. See **Lugworm.**

Local anaesthesia. See **Anaesthesia.**

Local government generally refers to the government of an area smaller than a country, state, or province. Such areas include counties, cities, towns, and villages. Each unit of local government has some important responsibility for the welfare of its citizens and provides certain services. Most local governments are run by elected officials and have some power of taxation. The main functions of local government vary from country to country. They often include road building and maintenance, regulation of building standards, public health, refuse collection, and local amenities such as public parks. In some countries, local governments are also responsible for social services, education, and police.

The degree of local authority and independence varies from nation to nation. In some countries, governmental authority has been decentralized so that many important decisions are made at the local level. In other countries, authority is centralized in the national government. Most countries have either a *federal* or a *unitary* system of government.

Federal systems divide the powers of government between the national government and the state or provincial governments. In most cases, the powers are set forth in a constitution. Although the state and provincial governments have legal control over local governments, they may give some authority to local units. Australia, Canada, Switzerland, and the United States, have federal systems of government. Local governments usually have more authority under federal systems than they have under unitary systems.

Unitary systems give most of the chief powers to the central government. All local, state, and provincial governments are subject to control by the central government. They have only those powers that the central government gives them. Great Britain, Norway, and Sweden have unitary systems. In these countries, local areas have considerable self-government, though they are under the central government's control. They have broad taxing powers and much authority for providing education, housing, and transportation.

In France, which also has a unitary system, the central government has strict and detailed control over local government units. However, local elected assemblies have some powers once held by a *prefect* (administrator) appointed by the central government. Italy and a few Latin-American countries still use prefects to supervise local governments. The prefects can veto actions of the local government. The people elect local councils in France and Italy. In France, the local council chooses a mayor from among its members. In Italy, the people elect the mayor.

Australia has a federal system of national government. In addition to the federal parliament, there are six state parliaments which make laws on such matters as education. Vast areas of Australia are too thinly populated to have local governments. But the whole of Victoria and Tasmania, and the more thickly populated parts of the other states, are divided into local government areas.

In Tasmania, all local government authorities are called *muncipalities.* In the mainland states, they are divided into rural shires or districts, and urban cities, towns, and municipalities. In urban areas, the different types are based partly on population and partly on financial resources. Only in the city of Brisbane is the whole metropolitan area under the control of a single authority, the city council. The other state capitals are divided into a large number of government authorities, many of them called *cities.* Various types of special-purpose authorities covering the whole metropolitan area deal with such matters as urban transport, sewerage, and overall urban planning.

New Zealand has about 500 local government authorities. The largest authorities are the regional councils of Auckland and Wellington. There are 20 united councils, whose members are not elected, but are appointed by the regional authorities. The regions of the 20 united and the 2 regional councils of Auckland and Wellington cover all of New Zealand apart from two counties: Great Barrier Island County and Chatham Islands County.

The number of county and municipal authorities has fluctuated because of reorganizations. There are county councils, city councils, borough councils, district councils, and community and district councils. In addition, there are boards such as hospital and electric power boards which have responsibility for particular services. New Zealand's local authorities are elected every three years.

India is divided into 23 states and 9 territories for national government. Each state has a governor, a chief minister, and a legislature. Most of the members of the legislature are elected by the people. Others are appointed by the governor. The nine territories are ruled by officials appointed by the federal government.

The basic unit of local government in India is the *panchayat,* or village council. This is a group of elders of the village, who are elected by all adults living in the village. Similar types of village councils run local governments in many countries.

Local government in the British Isles is controlled mainly by unpaid elected *councillors.* Paid officials act on decisions made by the councillors, decisions that reflect laws and policies of the national governments of Britain or the Republic of Ireland.

National government is responsible for such areas as income tax and defence. But local authorities have wide powers in certain other areas. These include control of advertising, education, housing, public health, recreation, roads, and many aspects of town and country planning. The work of local authorities is concerned with meeting immediate needs within their own areas.

Locarno Conference resulted in the Rhineland Security Pact and six other treaties. In October 1925, representatives of seven European countries met in Locarno, Switzerland, to discuss plans for building permanent peace in Europe. Delegates came from Belgium, Czechoslovakia, France, Germany, Great Britain, Italy, and Poland. The most important problem of the conference was to find a settlement between France and Germany. For the first time since World War I, the conference treated Germany as a friendly nation. When the conference ended on Oct. 16, 1925, the delegates had signed seven treaties.

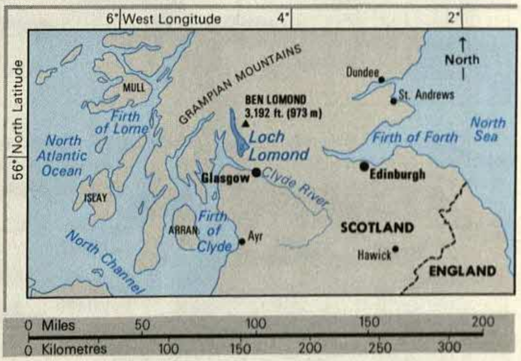
The Rhineland Security Pact developed as the most important of these treaties. Belgium, France, Germany, Great Britain, and Italy signed the pact. Belgium, France, and Germany agreed never to fight each other again. Germany agreed to join the League of Nations. The treaty set up a neutral zone in the Rhineland, an area covering Belgian, French, and German soil. All signing powers vowed to guarantee the frontier between France and Germany and between Belgium and Germany. This meant that if Germany attacked France, the other nations would go to the aid of France.

The six other Locarno Conference treaties bound the participating nations to the peaceful settlement of international quarrels. Each country promised to discuss its problems before resorting to war.

In 1936, Germany denounced the Locarno treaties and sent its troops into the neutral Rhineland. The other Locarno powers did not act to prevent the aggressions that brought on World War II.

Loch Lomond is the largest and one of the most famous of the Scottish lakes. The lake lies about 32 kilometres northwest of Glasgow in the Scottish highlands. Loch Lomond is in a hilly region, and its waters have many islands. The lake is 37 kilometres long and 8 kilometres wide at its widest point. One of the most familiar Scottish folk songs is about Loch Lomond. In ancient days, Scottish clans gathered for meetings at the edge of this lake.

Loch Lomond

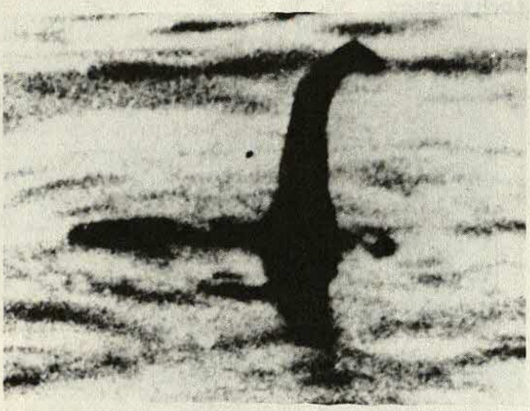


Loch Ness monster is a large animal that some people believe lives in Loch Ness, a lake in northern Scotland. If such a creature exists, it avoids people. But hundreds of people have reported seeing the animal, which is nicknamed "Nessie." They describe it as measuring up to 9 metres long. The creature supposedly has flippers, one or two humps, and a long, slender neck. Some scientists think Nessie may be related to a dinosaurlike reptile or to a modern sea animal, such as the manatee or seal.

The earliest known description of a strange creature in Loch Ness dates from A.D. 565. Reported sightings increased during the 1930's, when a new road made the lake more accessible to travellers.

In 1960, a British aircraft engineer named Tim Dinsdale made a short film of a dark shape moving through Loch Ness. Aerial photography experts from Great Britain's Royal Air Force reported that the film probably showed an "animate object"—that is, a living thing. Since then, several scientific expeditions have explored the waters of the lake. Investigations with *sonar,* a device

Corpach Paper Mill is near Fort William in Lochaber district. It is ideally placed in the Scottish Highlands to take advantage of plentiful local supplies of water and pulp from locally grown timber.



This photograph of the Loch Ness monster was revealed as a hoax after 60 years. It was taken by British doctor, Robert Wilson, and shows a model built by his stepson, Christian Spurling.

that uses sound to detect underwater objects, have found large moving bodies in Loch Ness.

In 1972 and 1975, researchers from the Academy of Applied Science in Boston, U.S.A., took underwater photographs of what they claimed was the Loch Ness monster. However, experts do not agree on exactly what the photographs show. The Loch Ness monster has been given the scientific name *Nessiteras rhombopteryx* so it can be protected by a British law that safeguards rare animals.

Lochaber (pop. 20,803), a local government district in Highland Region, Scotland, takes in the areas of Fort William, Ballachulish, Kinlochleven, and Ardnamurchan. Fort William is a tourist centre. Corpach, nearby, is a centre of papermaking. Workers produce aluminium at the village of Kinlochleven and at Fort William. Mallaig is a fishing port. Crofters in Lochaber rear sheep and cattle and grow vegetables. Lochaber has much beautiful scenery, especially around the Ardnamurchan peninsula. Glen Coe, where the Campbells slew the MacDonalds, is in the district of Lochaber. The district includes Ben Nevis, the United Kingdom's highest mountain. See also **Highland Region.**

Lock, in canal construction. See **Canal** (Canal locks; pictures).

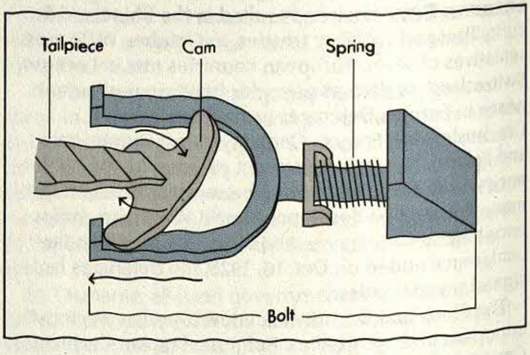
Lock is a device that prevents a door or other objects from being opened or moved. People use locks to help protect themselves and guard their property against theft. For example, door locks provide protection for homes, and bicycle locks prevent the theft of bicycles.

There are many kinds of locks, and nearly all require a key to be opened. Types of locks that do not require a key include combination locks, time locks, chain locks, and some electronic door locks. Combination locks are opened by turning a dial to the correct combination of numbers. Time locks, a type of combination lock, can be opened only at a specific time at which the lock has been set. Chain locks have a metal chain that fastens to the inside surface of a door and to the doorframe. Electronic door locks open when a person inserts a coded plastic card into a slot beside the door.

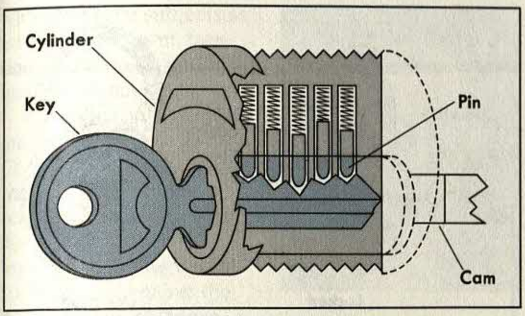
Locks give maximum security when used on sturdy objects. A bicycle lock offers little protection against the theft of a bike if its chain can be easily cut or removed.

How door locks work

All door locks have some type of *bolt* that prevents the door from being opened. In most door locks, the bolt slides into a metal plate in the doorframe. A long, narrow piece of metal called a *cam* controls the move-



The bolt of a door lock slides back and forth. A long piece of metal called a *cam* controls the movement of the bolt.



The key is inserted into the cylinder-locking mechanism. The grooves of the key force the pins of the mechanism to align. This action frees the key to turn and thus activate the cam.

ment of the bolt. The cam is fastened to a *cylinder-locking mechanism* in the door.

People use a key to operate a door lock from the outside. They lock and unlock a door from the inside by turning a knob or a key. When a person inserts the proper key in a door lock, the grooves of the key force metal pins or plates called *tumblers* to align. When the tumblers are in line, the key is free to turn and activate the cam. The cam moves the bolt between the door and the doorframe.

The bolts used in most door locks are either *spring bolts* or *deadbolts.* Spring bolts are the most common type of bolt. They are convenient to use because they do not require a key to be locked. Spring bolts simply snap into the doorframe when the door closes and are held in place by a metal spring. However, locks with spring bolts do not provide good security because they can easily be opened without a key. Some spring bolts can be pried open by slipping a thin object between the door and the doorframe.

Deadbolts are the most secure type of bolt. Most of them are mounted into a steel frame on the inside surface of a door. These kinds of deadbolts lock with a key on the outside and by turning a small knob on the inside. Other deadbolts are set in the door and controlled by the cam. They are "dead" because they cannot be pried open.

Kinds of locks

The six most common types of locks are (1) mortise locks, (2) rim locks, (3) cylindrical locks, (4) tubular locks, (5) combination locks, and (6) padlocks. Each type has its own shape and design and works differently.

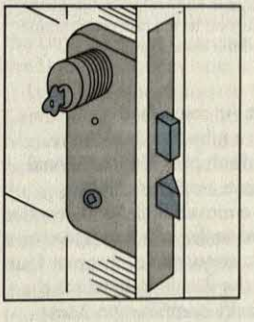
Mortise locks have the locking mechanism *mortised* (cut) into the door. The doorknobs screw into the locking mechanism. Mortise locks have either spring bolts, deadbolts, or both. A deadbolt measuring about 2.5 centimetres long provides maximum security. A key unlocks the door from the outside, and a small knob or a key unlocks it from the inside. Mortise locks are extremely strong when installed in a sturdy door.

Rim locks provide additional security to doors already equipped with one or more other locks. They have a bolt mechanism mounted into a frame on the inside surface of the door.

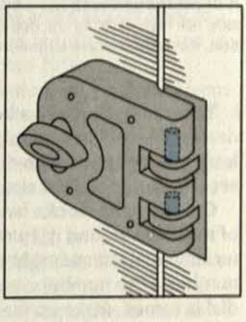
Rim locks have a round cylinder that is set in the door. A connecting bar extends through the door and connects the cylinder with the deadbolt. Rim locks open with a key on the outside and by turning a knob or key inside.

Cylindrical locks are found on household doors in many countries. These kinds of locks are sometimes called *knob locks* because the cylinder-locking mechanism is part of the doorknob. Cylindrical locks have a keyhole in the doorknob.

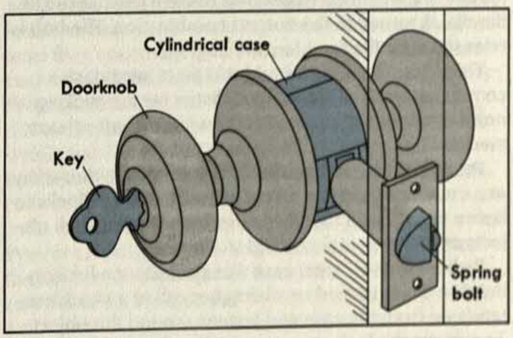
Most cylindrical locks have a spring bolt. Some, called *pick-resistant locks,* have deadbolts. A key unlocks the door from the outside, and a small knob or a key unlocks it from the inside.



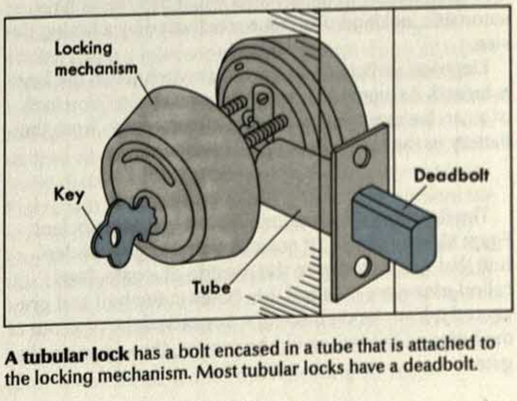
A mortise lock is cut into a door. The lock shown has a spring bolt and a deadbolt.



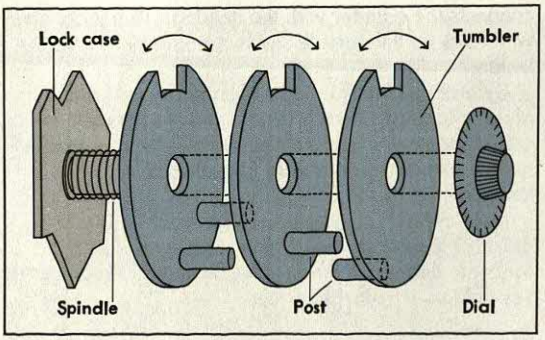
A rim lock has a bolt enclosed in a frame mounted on the inside surface of the door.



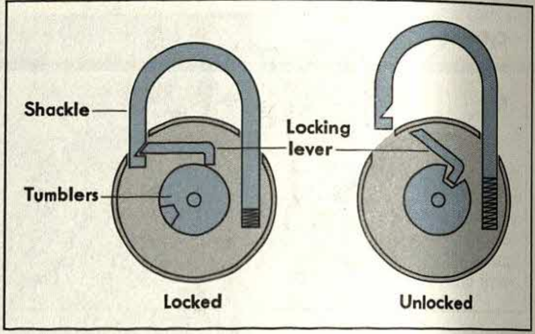
A cylindrical, or knob, lock has a locking mechanism that is part of the doorknob. Most of these locks have a spring bolt.



A tubular lock has a bolt encased in a tube that is attached to the locking mechanism. Most tubular locks have a deadbolt.



A combination lock has a dial that is connected to tumblers inside the lock case. As the dial is turned to the correct combination, the tumblers are aligned and the bolt is released.



A padlock is a portable lock that has a steel case containing the locking mechanism. Padlocks require either a combination, *above,* or a key to release the *shackle* and open the lock.

Tubular locks have a bolt—in most cases a deadbolt—that is enclosed in a tube attached to the locking mechanism. The deadbolt provides additional security for doors that also have a cylindrical lock.

Combination locks have a movable dial with a series of numbers around it. To release the lock, a person must turn the dial left and right in a sequence of three or four numbers. The numbers, and the direction in which the dial is turned, make up the lock's *combination.* Most floor safes and wall safes are protected by combination locks.

A combination lock has disc-shaped tumblers. The tumblers are aligned with a bolt-release mechanism as the dial is turned to the correct combination. The bolt is released after the tumblers are aligned.

Thieves can easily *pick* (unlock) most inexpensive combination locks. They simply listen for the clicking noise of a tumbler being aligned with the bolt-release mechanism.

Padlocks are portable locks that require either a key or a combination to be opened. People use padlocks to fasten two objects together or to help protect such objects as bicycles, lockers, and trunks.

Padlocks have a steel case that contains the locking mechanism. A curved revolving bar called a *shackle* extends up from the case and fastens around the object. To activate the lock, a person pushes the bar through a hole in the case.

Other kinds of locks include *time locks* and *electrical switchlocks.* Time locks are a type of combination lock used mainly in bank vaults. Most time locks have automatic locking bolts that are activated by a timing device.

Electrical switchlocks operate a switch when the key is turned. As a person turns the key in the ignition lock of a car, for example, an electric current flows from the battery to the starter.

History

The first key-operated lock was invented in ancient Egypt about 2000 B.C. It consisted of a large wooden bolt that was fastened to the outside of a gate. Pegs called *pins* were inserted into holes in the bolt and prevented it from being moved. A key raised the pins out of the holes so the bolt could be moved, thus opening the gate.

Later, locks were developed according to three basic locking principles: (1) the warded principle, (2) the lever principle, and (3) the pin-tumbler principle. The ancient Romans invented the warded principle. In padlocks and other warded locks, the mechanism contains a series of *wards* (obstacles) that the key must pass in order to unlock the bolt. Warded locks were the most common locks until the mid-1800's, and many are still used.

The lever principle was developed in the late 1700's. Lever locks have one or more levers in their mechanism. The levers must be raised to a specific height before the bolt can be removed. Only the correct key can raise the levers to precisely the height needed to remove the bolt.

The modern pin-tumbler lock was invented in 1865 by an American locksmith named Linus Yale, Jr. It was based on a principle similar to that of the ancient Egyptian lock. The pin-tumbler lock, used in most doors today, is one of the most secure key-operated locks ever invented. It also was the first lock to be mass-produced.

See also **Time lock; Yale, Linus, Jr.**

Locke, Alain Leroy (1886-1954), was an American educator and a writer on black culture. From 1912 to 1953, he taught philosophy at Howard University. His works include *The Negro in America* (1933), *The Negro and His Music* (1936), *Negro Art—Past and Present* (1937), and *When Peoples Meet* (1941). In 1942, he was selected in a poll as one of the most distinguished blacks of the year. Born in Philadelphia, Locke studied at Oxford, Berlin, and Harvard universities.

Locke, John (1632-1704), was an English philosopher. His writings have influenced political science and philosophy. Locke's book *Two Treatises of Government* (1690) strongly influenced Thomas Jefferson in the writing of the U.S. Declaration of Independence.

His life. Locke was born in Wrington in the county of Somerset, England. He attended Oxford University. In 1666, he met Anthony Ashley Cooper, who later became the first Earl of Shaftesbury. The two men became close friends. In 1679, the earl became involved in plots against the king, and suspicion also fell on Locke. The philosopher decided to leave England. In 1683, he moved to the Netherlands, where he met Prince William and Princess Mary of Orange. William and Mary became the rulers of England in 1689, and Locke returned to England as a court favourite. Until his death, he wrote widely on such subjects as educational reform, freedom of the press, and religious tolerance.

John Locke

His philosophy. Locke's major work was *An Essay Concerning Human Understanding* (1690). It describes his theory of how the mind functions in learning about the world. Locke argued against the doctrine of innate ideas, which stated that ideas were part of the mind at birth and not learned or acquired later from outside sources. Locke claimed that all ideas were placed in the mind by experience. He declared that there were two kinds of experience, outer and inner. Outer experience was acquired through the senses of sight, taste, hearing, smell, and touch, which provide information about the external world. Inner experience was acquired by thinking about the mental processes involved in sifting these data, which furnished information about the mind.

Locke believed that the universe contained three kinds of things—minds, various types of bodies, and God. Bodies had two kinds of properties. One kind was mathematically measurable, such as length and weight, and existed in the bodies themselves. The second kind was qualitative, such as sound and colour. These properties were not in the bodies themselves but were simply powers that bodies had to produce ideas of colours and sounds in the mind.

According to Locke, a good life was a life of pleasure. Pleasure and pain were simple ideas that accompanied nearly all human experiences. Ethical action involved determining which act in a given situation would produce the greatest pleasure—and then performing that act. Locke also believed that God had established divine law. This law could be discovered by reason, and to disobey it was morally wrong. Locke thought that divine law and the pleasure principle were compatible.

Locke believed that people by nature had certain rights and duties. These rights included liberty, life, and ownership of property. By liberty, Locke meant political equality. The task of any state was to protect people's rights. States inconvenience people in various ways. Therefore, the justification for a state's existence had to be found in its ability to protect human rights better than individuals could on their own. Locke declared that if a government did not adequately protect the rights of its citizens, they had the right to find other rulers. He believed that the people should decide who governs them.

See also **Civil rights** (Natural rights); **Democracy** (Democracy in Britain); **Empiricism; Philosophy** (Modern philosophy).

Lockjaw. See **Tetanus.**

Lockout occurs when an employer closes a factory in order to keep employees from working. The employer is using the economic weapon of a work and wage stoppage to get employees to agree to some particular condition of work or wages. The lockout is like the *strike* in that it is an economic weapon used in labour disputes. The lockout differs from the strike, however, because the strike is a work stoppage the employees start to compel the employer to meet certain demands.

Lockouts, like strikes, are usually caused by wage disputes. Lockouts make up only a small percentage of the total number of work stoppages that occur. The reason the percentage is so low is that employers are reluctant to shut their own facilities. They sometimes have more direct and effective means of placing economic pressure on workers, such as replacing workers involved in labour disputes.

See also **Strike.**

Lockspeiser, Sir Ben (1891-1990), was a British scientist and science administrator. His early research work included the design of aircraft and investigations of aircraft icing and wing stability. He acted as secretary of the Department of Scientific and Industrial Research in the United Kingdom from 1949 to 1956.

Lockspeiser was born in London. He graduated from Cambridge University and studied at the Royal School of Mines before entering the Scientific Civil Service. He believed in all-round scientific education and advocated the application of science to government as well as to everyday affairs.

Lockwood, Douglas (1918-1980), an Australian author, wrote *I, the Aboriginal* (1963). This biography tells the story of Waipuldanya, an Aborigine of the Alawa tribe in the Roper River district. Waipuldanya was an employee of the Commonwealth Health Department in the Northern Territory. He was known in Darwin as Philip Roberts. An outstanding biography, *I, the Aboriginal* is important for its sympathetic insight into the outlook and customs of the tribal Aborigines and the problems they encountered in reconciling two ways of life. Lockwood's other books include *Crocodiles and Other People* (1959), *We, the Aborigines* and *Up the Track* (1964), *The Lizard Eaters* (1965), *Australia's Pearl Harbor* (1966), and *The Front Door* (1968).

Lockyer, Edmund (1784-1860), a British soldier, discovered coal while exploring the Brisbane River in Australia in 1825. In 1826, Governor Darling sent Lockyer to Western Australia in the brig *Amity.* Lockyer annexed the territory in the name of Britain before the French could claim it. He founded the town of Albany in Western Australia and returned to Sydney in 1827. Lockyer was born in Devon, England. He joined the British army in 1803 and arrived in Australia in 1825.

Lockyer, Joseph Norman (1836-1920), a British astronomer, discovered the element helium on the sun about 30 years before helium was found on earth.

Lockyer started investigating the sun during the 1860's, using a telescope with a spectroscope attached. This allowed him to observe the *spectra* of different types of light coming from the sun. In 1868, he observed the spectra of *prominences* (solar flares) during a solar eclipse and found that prominences are gaseous. The same discovery was made by the French astronomer Pierre Janssen, working in India. Both astronomers observed a spectral line that did not correspond to any chemical element then known. Lockyer concluded that this line had to be produced by a new element, which he termed *helium,* after *helios,* the Greek word for sun.

In 1869, Lockyer was elected to the Royal Society, and in the same year he founded the scientific journal *Nature,* which he edited for the following 50 years.

Diesel locomotives pull most freight and passenger trains and handle most shunting work. The diesel-electric, *above,* is the most widely used kind of diesel in the world.

Electric locomotives run on power supplied by an electric power plant. These locomotives are especially useful for hauling high-speed passenger trains or fast, heavy freight trains.

Locomotive is a machine that moves trains on railway tracks. Early locomotives weighed from 2.5 to 5.5 metric tons and could pull or push only a few light cars. A modern locomotive may weigh over 640 metric tons and move more than 200 loaded freight cars at a time.

There are three main kinds of locomotives, depending on their source of power: (1) diesel, (2) electric, and (3) steam. A fourth kind is powered by machines called *gas turbines.* Such turbines resemble those used in aircraft. Turbotrains do not have locomotives. Instead, their power units are built into one or more of the cars.

Steam locomotives once pulled most trains, and they are still used in some countries. But in most industrialized countries, diesel and electric locomotives have replaced steam locomotives almost entirely. Steam locomotives are still widely used in countries where coal is in large supply, as for example, China. Also their construction and maintenance is simpler than other types, and therefore they are used in areas with little industrialization. In Britain, the United States, and some other countries, steam locomotives pull tourist trains or are operated by steam enthusiasts.

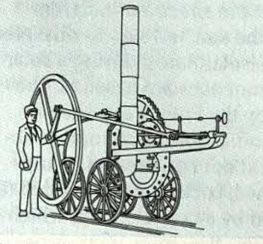
Kinds of locomotives

Diesel locomotives are actually travelling power plants. They have a diesel engine that works by compressing air in chambers called *cylinders.* When air is compressed, its temperature rises. The resulting heat ignites fuel that has been injected into the cylinder. The power produced during this process is then transmitted to the locomotive's driving wheels. For more detailed information on how a diesel engine works, see the *World Book* article on **Diesel engine.**

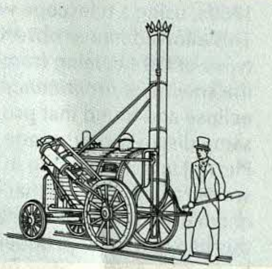
Diesel locomotives have a number of advantages. They generate their own power and therefore can operate anywhere that there are rails. Diesel locomotives can also make long runs without refuelling or servicing. They can be quickly stopped or started, and they speed up faster than steam engines. They also have a higher fuel efficiency than steam locomotives, require less servicing, and cost less to maintain.

A diesel locomotive may be a single unit, or it may consist of from one to four connecting units. Single diesel units range from 400 to 6,000 horsepower each. But

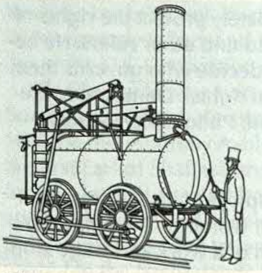
Historic locomotives Many early locomotives contributed to the development of today's streamlined models.



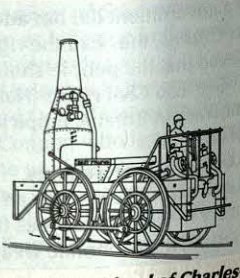
The first locomotive was a simple steam engine built by Richard Trevithick of England. It made its first run in 1804.



The *Rocket,* the first truly successful steam locomotive, was built by George Stephenson of England in 1829.



The *Stourbridge Lion,* a steam engine, in 1829 became the first full-sized locomotive to run in North America.



The *Best Friend of Charleston,* the first U.S. steam locomotive put in regular service, began operating in 1830.

Steam locomotives hauled nearly all trains before the invention of the diesel. Today, such steam engines as the one above still provide train service in some parts of the world.

two 2,000-horsepower units coupled together make a 4,000-horsepower locomotive. Three such units produce a 6,000-horsepower locomotive, and so on.

Railwaymen use a system of letters and numbers to classify the types of diesel locomotives by the number of driving axles and *idling* (non-powered) axles they have. The letter *A* stands for one driving axle, *B* for two, *C* for three, and *D* for four. The number *1* stands for one idling axle, *2* for two such axles, and so on. In most locomotives, the axles are combined into swivelling units called *bogies.* An *A1A-A1A* locomotive has two 6-wheel bogies, each bogie with a centre idling axle. A *C-C* locomotive has two 6-wheel bogies, and all axles driving.

Diesel engines of low and medium power may be fitted into *rail-cars.* A rail-car is a self-propelled rail vehicle in which most of the space is available for passengers or parcels. Or several diesel engines may be placed at intervals in a train of two or more coaches that are never separated in service. Railwaymen call such trains *multiple-unit* trains. Two or more multiple-unit trains may be combined to operate under the control of one driver.

There are three types of diesel locomotives: (1) diesel-electric, (2) diesel-hydraulic, and (3) diesel-mechanical. Each transmits power from the engine to the driving wheels in a different way.

Diesel-electric locomotives are by far the most common type. In these locomotives, the engine drives a machine called a *generator,* which produces an electric current. The current is then fed to *traction motors,* which drive gears that turn the locomotive's driving wheels. Most diesel-electrics have generators that produce *direct current* (DC), a kind of current that flows in only one direction. Generators on some newer, large diesels produce *alternating current* (AC), which reverses direction many times every second. Most diesels have traction motors that operate on direct current. Therefore, locomotives with an AC generator must *rectify* (convert) the alternating current into direct current before it goes to the motors. Devices called *silicon rectifiers* perform this conversion.

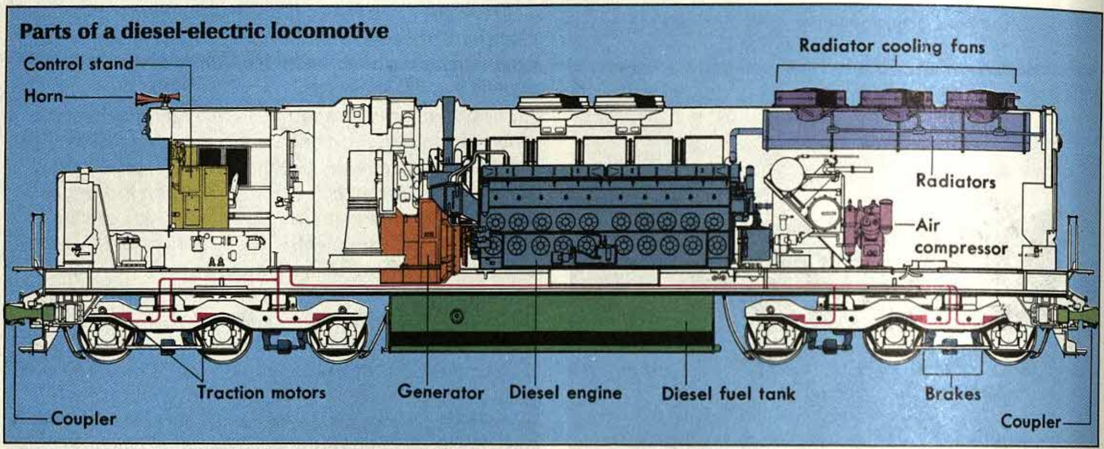
Diesel-hydraulic locomotives. In this type of locomotive, the engine drives a *torque converter* instead of a generator. A torque converter is a device that uses fluids under hydraulic pressure to transmit and regulate power received from the engine. The converter includes a pump and a turbine. The turbine changes energy from the fluids into a force that can be used to perform work. The engine delivers oil to the converter and drives the pump. The pump forces the oil against the blades of the turbine. This action causes the turbine to rotate and to drive a system of gears and shafts that move the wheels.

Diesel-hydraulic locomotives are not as widely used as diesel-electric locomotives. However, they are widely used in some countries, especially in Germany, where they first appeared.

Diesel-mechanical locomotives transmit power from the engine in much the same way that cars do—through a clutch and a system of gears and shafts. The clutch connects the engine to the transmission. The gears and shafts fit together to transmit the power and drive the wheels. This mechanical drive delivers less power than do other systems, and so it works well only on small locomotives.

Electric locomotives, unlike diesels, do not produce their own power. They use electric power supplied by a central power plant that may be far away. Therefore,

A diesel-hydraulic locomotive transmits the engine's power to the driving wheels by using a liquid under pressure. This Chinese locomotive is used for passenger services to Beijing.



Inside a diesel-electric locomotive, a diesel engine turns a generator. Electricity produced by the generator runs traction motors that drive the wheels. An engineer regulates power and speed at the control stand, and the air compressor powers the brakes. The radiator equipment keeps the engine from overheating. *Couplers* connect the locomotive with other units.

an electric locomotive needs special wires or rails from which it can get power.

Many electric locomotives use alternating current. They obtain the power from an overhead wire called a *catenary.* A hinged steel framework called a *pantograph,* which conducts electricity, connects this wire with the locomotive. Locomotives that operate on alternating current receive power at extremely high voltages. They have a device called a *transformer* that reduces the voltage to a level at which it can be used. The power is then fed into AC traction motors, or it is rectified and fed into DC traction motors.

Some locomotives that operate on direct current also obtain power by way of a catenary and pantograph. Other DC locomotives use an *electrical third rail,* which runs parallel to the regular rails. A metal device called a *contact shoe* is attached to these locomotives. The shoe slides along the rail and picks up electricity from it.

An electrified rail network costs a tremendous sum to build because of the wires and other special equipment involved. However, electric locomotives can draw vast amounts of power from their central power plant. Diesels, on the other hand, are limited to the power they can produce from the fuel they carry. Electric locomotives can be started instantly. They also are quiet and produce no smoke or exhaust gases. Thus, they are

Steam engine 799 hauls the morning train from New Jalpaiguri to Darjeeling, in West Bengal, northeastern India. The narrow-gauge line provides one of the world's most spectacular railway journeys. The little engines work hard, taking about seven hours to complete a long, winding journey climbing nearly 2,000 metres into the Himalaya. Locomotives to this design were built between 1892 and 1927.

sometimes used in heavily populated areas and on railways that run underground or through long tunnels.

Like diesels, most electric locomotives can operate either singly or combined in groups of two or more units. However, electric locomotives can produce more power per unit than diesels can. Therefore, electric locomotives are especially useful for fast, heavy freight trains or high-speed passenger trains.

Many kinds of fuel can be used by a power plant to produce the electricity that runs an electric locomotive. For example, a power plant may use coal, gas, oil, water power, or atomic power. Diesel locomotives can run only on diesel oil, which one day may become scarce and costly.

Steam locomotives produce heat by burning coal or fuel oil in a *firebox.* The heat turns the water in the locomotive's *boiler* into steam, which is fed into cylinders. There, the pressure produced by the steam drives steel rods called *pistons.* The pistons are connected to *piston rods, main rods,* and *side rods,* which move the driving wheels. A steam locomotive has an attached car called a *tender* that carries the fuel and water.

Steam locomotives have several disadvantages. For example, a steam locomotive needs frequent care, especially to keep the fire burning in the boiler. A long time is required to light the fire and to heat the boiler so that steam can be produced. In addition, steam locomotives cannot maintain the high average speeds of diesel or electric locomotives. They also have low fuel efficiency. A steam locomotive must burn large amounts of fuel to produce power, but little of the heat produced is used to run the locomotive. The rest is wasted.

Other kinds of locomotives include gas-turbine locomotives, which have a power unit consisting of a compressor, a combustion unit, and a turbine. The compressor forces compressed air into the combustion unit where oil, natural gas, or finely powdered coal is burned. This combustion produces a blast of hot gases that operate the turbine. The turbine drives first a compressor. A turbine with electric transmission then drives one or more electric generators. The generators supply current to the traction motors. But a turbine with mechanical transmission then drives *reduction gears.* The gear wheels and side rods transmit the drive to the wheels.

Gas turbines have good efficiency only when they work for long periods under a heavy load. For this reason, most gas-turbine locomotives operate on 1,000-kilometre runs on slight, continuous gradients with fast and heavy freight trains.

History

Richard Trevithick, a British inventor, was the first man to build a workable steam locomotive. He built it in 1804. George Stephenson, a British mining engineer, and other engineers built locomotives. The first locomotives had many failings. Not until 1829 did Stephenson build the *Rocket,* the first really successful locomotive. The *Rocket* succeeded because it was the first locomotive to be designed and built with a blast-pipe and a multitubular boiler.

Railways were built throughout the world during the 1800s. Many able engineers improved steam locomotives so that they could pull greater loads, travel faster, and work more efficiently. Engines with large driving wheels attained high speeds. Later, engineers fitted smaller wheels which were coupled together to give greater traction. Larger boilers could be fitted above the smaller wheels.

At first, the various railways used track of any convenient gauge. But by the end of the 1800s, most railways in Europe and North America used the same standard gauge. As a result, locomotives made in one country could be sold and used in any other country. But many narrow-gauge railways were also built and still operate in mountainous countries. By the 1930s, steam locomotives reached their peak of mechanical development. Later locomotives differed only in size.

The first electric locomotives were built towards the end of the 1800s. Many men contributed to their development. The German firm of Siemens and Halske built the first practical electric locomotive in 1879. Thomas Edison tested his first model in 1880. In 1895, the first large main-line electric locomotives began regular service in the United States. Underground railways use only electric locomotives.

The first diesel locomotives and rail-cars began service in 1912 and 1913. But in the 1930's lightweight diesel trains broke rail speed records in Germany and the United States. But the great change from steam to diesel

The 'Red Devil', in service in South Africa, is one of the world's most modern steam locomotives.

Electric locomotive 91-010 is one of the latest types used for British Rail's Intercity express services.

traction on many railways has taken place since World War II (1939-1945).

Related articles in *World Book* include:

Electric railway
Free-piston engine
Railway
Rocket, The
Steam engine
Stephenson

Locomotor ataxia. See Ataxia.

Locoweed is any one of several kinds of perennial herbs that grow in western North America. They have harmful effects when eaten by horses, cattle, or sheep. Locoweed gets its name from the Spanish word for *crazy,* because of the strange actions of animals poisoned by it.

There are about a hundred kinds of locoweeds, but many are not known to be poisonous. Three of the more common kinds are the *white, purple,* and *blue* locoweed. They are named for the colour of their flowers, which resemble those of peas or beans. The plants have erect or spreading stems with many leaflets on each stem.

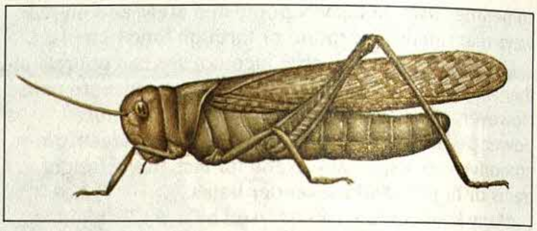
The effect of locoweeds on animals depends on the soil in which the plants grow. Scientists believe that the plants' poisonous effects result from their ability to absorb poisonous elements from the soil. Both the green and the dry plants are poisonous. The symptoms of poisoning vary somewhat in horses, cattle, and sheep. Horses become dull, drag their legs, eat infrequently, and lose muscle control. Soon they become thin and die. Cattle react in much the same way. But sometimes they run wildly about, bumping into objects in their path. Sheep react more mildly to the poison. Animals raised on a range usually do not eat locoweeds when other food is available. Ranchers destroy locoweeds by cutting the roots about 5 centimetres below the surface, or by spraying the plants with the herbicide 2,4-D.

Scientific classification. Locoweeds belong to the pea family, Leguminosae (Fabaceae). The white locoweed is *Oxytropis lambertii;* the purple is *Astragalus mollissimus;* and the blue is *A. diphysus.*

Locust is a name that can refer to any short-horned grasshopper—that is, a grasshopper with short *antennae* (feelers). However, the name *locust* is most often given to short-horned grasshoppers that migrate. There are about nine kinds of these grasshoppers. Every continent has its own kind of migratory locust.

Most migratory locusts are about 5 centimetres long, with a large head, large eyes, and short antennae. They have long hind legs for jumping, and four wings that fold over their backs when they are not flying. Many locusts can make a sound by rubbing their ridged hind legs on their front wings. This causes the wings to vibrate and makes the noise.

Conditions that cause the migration of locusts are not fully understood. However, scientists know that migration takes place only after a large number of females lay their eggs close together. This may occur because of a food shortage or because of local flooding. The young that hatch from these eggs remain together and live as a group. They meet other groups of young grasshoppers and form a swarm. There may be millions of migratory grasshoppers in a locust swarm. The adults may fly long distances. Wherever they land, they eat and destroy vegetation. Eventually, the locusts become separated. Many generations of solitary locusts may be produced before conditions are right to produce another swarm.



The locust, a type of grasshopper, has a large head, short antennae, and long legs. Its wings help it fly great distances.

A swarm of locusts flies over a field in Ethiopia. Since ancient times, locusts have plagued farmers throughout the world.

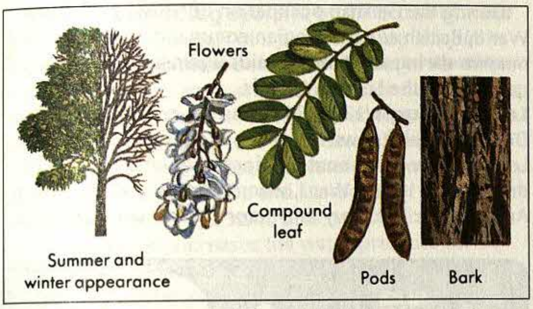
Plagues of crop-destroying locusts have been known since ancient times. The Rocky Mountain locust of North America destroyed millions of dollars worth of crops in the Mississippi Valley between 1870 and 1880. The most serious locust pest is undoubtedly the Old World *desert locust.* One swarm by the Red Sea was believed to cover an area of 5,200 square kilometres. The last *upsurge* (build up of its numbers) occurred in 1987 and 1989. The invasion area of this species includes West, Central, and North Africa, reaching into Spain and Portugal, the Middle East, across the southern Soviet Union through Pakistan and India.

Swarms of migrating locusts are sometimes so large they shut out the sunlight. They interfere with trains and planes and make car travel dangerous. Millions of crushed locust bodies make rails and roads slippery. Swarms travel great distances and have been seen as much as 1,930 kilometres from land.

Scientists and farmers have found several ways to fight locusts. Because grasshoppers lay their eggs in the autumn, ploughing the soil in the late autumn destroys the eggs. When large numbers of grasshoppers hatch, farmers must poison them as soon as possible.

Scientific classification. Locusts belong to the family Acrididae.

See also **Grasshopper; Plant** (picture: Insects damage large numbers of plants).



The black locust is a popular shade tree.

Locust, or *false acacia,* is any of about 20 plants native to North America. Four of these are shade trees with heavily scented flowers. The others are shrubs. The trees sometimes grow about 25 metres tall.

In the United States, the *black locust,* or *common acacia,* is the best-known locust tree. It is one of the most widely planted North American trees in Europe. Like most locusts, the black locust has prickly branches. Its fragrant white flowers hang in drooping clusters. The fruit of the locust tree consists of a long, glossy brown pod with about a dozen wax-coated seeds. Black locusts have blue-green compound leaves. The bark and leaves of the black locust are poisonous.

Locusts grow rapidly on good soil. On poor soils, locust borers kill the trees while they are still young. Another insect enemy, the leaf miner, may cause the leaves to turn yellow and fall off before the first frost.

Locust wood is commercially important because it is hard, long-lasting, and swells only slightly when wet. Locust trees make good fence posts and mine timbers.

Scientific classification. Locusts belong to the pea family, Leguminosae (Fabaceae). The black locust is *Robinia pseudoacacia.*

See also **Acacia; Honey locust.**

A black locust has blue-green leaves and drooping clusters of fragrant flowers. Its bark and leaves are poisonous.

Lodestone is a hard black rock that exhibits magnetic properties. It is made of the mineral magnetite.

According to legend, lodestone was discovered by a shepherd in Asia Minor (now Turkey) who noticed that the iron nails in his boots and the iron tip of his staff clung to the rock over which he was walking. The earliest record of production of lodestone is from an ancient country in Asia Minor called *Magnesia.* The earliest recorded name for the rock is *Heraclean stone,* from Heraclea, a city in the ancient country of Lydia.

About A.D. 1200, Europeans discovered that an oblong piece of this stone would point to the north and south if it were hung by a string. They called it a "leading stone," or *lodestone.* Lodestone made compasses possible, and sailors no longer had to steer by the stars. Today, the most powerful lodestones are found in Siberia, the island of Elba, and South Africa.

See also **Magnetism** (picture).

Lodge, Henry Cabot (1850-1924), led Republican members of the Senate in a successful fight to prevent the United States from joining the League of Nations after World War I (1914-1918). He opposed President Woodrow Wilson, the chief planner of the League. Lodge fought the League because he felt it would involve the United States too deeply in European affairs.

Lodge came from a wealthy Boston family. He graduated from Harvard University. He was a noted historian before being elected to the U.S. House of Representatives in 1886. As a Republican senator from 1893 until his death, he pioneered in civil service law and helped draft the Federal Food and Drugs Act of 1906.

Lodge, Henry Cabot, Jr. (1902-1985), served as a diplomat under four United States presidents. In 1960, he was the vice presidential running mate of Republican Richard Nixon, but they lost the election.

Lodge was born in Nahant, Massachusetts, and graduated from Harvard University in 1924. He won election to the U.S. Senate in 1936.

Under President Eisenhower, Lodge served as U.S. ambassador to the United Nations. He held a U.S. ambassador's post under successive presidents until 1969 when he became the chief negotiator at the Vietnam peace talks in Paris. Lodge retired from public office in 1977.

Lodge, Sir Oliver Joseph (1851-1940), an English physicist, investigated the nature of oscillations and electric waves in wires and in wireless telegraphy. His discoveries helped in developing the radio. His works include *Modern Views of Electricity* (1889), *Electrons* (1907), and *The Ether of Space* (1909).

Lodge served as professor of physics at University College, Liverpool. Later, he became deeply interested in spiritualism. He was knighted in 1902. Lodge was born in Penkhull, England.

Łódź (pop. 847,900) is the second largest city in Poland. Only Warsaw is larger. Łódź is the capital of the province of Łódź in central Poland. For location, see **Poland** (political map).

Łódź ranks as Poland's leading manufacturer of cotton cloth and other textiles. It also produces chemicals, electric appliances, machinery, and processed foods. The city is the centre of Poland's film industry and the home of the University of Łódź.

Łódź received a city charter in the early 1400's. It expanded rapidly when its textile industry developed during the 1800's. During World War II (1939-1945), German troops occupied Łódź, and it was severely damaged. The city was rebuilt after the war.

Loess is a kind of silt that forms a fertile topsoil in some parts of the world. Loess consists of tiny mineral particles brought by wind to the places where they now lie. These mineral particles are finer than sand but coarser than dust or clay. Topsoils made up of loess are found in the central and northwestern parts of the United States, in central and eastern Europe, and in eastern China.

Loesser, Frank (1910-1969), an American composer, wrote the music and lyrics for many musical comedies and films. He won the 1949 Academy Award for his song "Baby, It's Cold Outside." Loesser and playwright Abe Burrows shared the 1962 Pulitzer prize for drama for the musical comedy *How to Succeed in Business Without Really Trying* (1961).

Loesser, whose full name was Francis Henry Loesser, was born in New York City. In 1936, he moved to Hollywood, where he wrote lyrics for film musicals. Loesser wrote the lyrics for a number of hit songs, including "Two Sleepy People" and "I Don't Want to Walk Without You." In the early 1940's, he began to compose both music and lyrics. Loesser wrote such songs as "On a Slow Boat to China" and "Spring Will Be a Little Late This Year."

Loesser's first successful musical comedy was *Where's Charley?* (1948). His next show, *Guys and Dolls* (1950), ranks among the finest musicals in history. It includes the songs "If I Were a Bell," "I've Never Been in Love Before," and "I'll Know." Loesser wrote the story as well as the music and lyrics for *The Most Happy Fella* (1956).

Löffler, Friedrich (1852-1915), a German bacteriologist, discovered the diphtheria bacillus in 1884, with the help of Edwin Klebs. He then found a way to cultivate these organisms, and perfected a staining method so that they could be more easily observed under a microscope. He also developed a staining technique to demonstrate flagella, the whiplike structures used to propel some bacteria. In 1897, Löffler and Paul Frosch discovered the first known animal virus, the one that causes foot-and-mouth disease in cattle. Löffler was born in Frankfurt an der Oder, Germany.

Lofoten Islands include several large islands and many islets off the northwest coast of Norway. They cover about 1,227 square kilometres and have a population of about 26,000. The Vesterålen archipelago to the north is sometimes considered part of the Lofoten Islands. The Vesterålen group covers 1,502 square kilometres and has about 33,000 people.

The Lofoten Islands are famous for their fisheries. The chief source of income is codfishing. The population of the islands doubles during the spring, when fishing enthusiasts come there to fish.

There are some industries on the islands. These include canning, quick-freezing, and processing of fish oil and fish meat. Svolvaer is the chief port of the islands. The famous whirlpool known as the Maelstrøm is between the islands of Moskenesøya and Vaerøy. The Maelstrøm is not really a whirlpool, but a strong tidal current that flows back and forth between the islands.

During the German occupation of Norway in World War II, British and Norwegian commando forces carried out two daring and famous raids against the German garrison on the Lofoten Islands.

Lofting, Hugh (1886-1947), was the creator of Doctor Dolittle, a well-known character in children's fiction. Lofting first wrote about the doctor in letters to his children during World War I, when he served in the British Army. When *The Story of Doctor Dolittle* was published in 1920, it won such popular favour that Lofting was persuaded to continue the adventures of Doctor Dolittle and his animal friends in *The Voyages of Doctor Dolittle* (1922). He received the Newbery Medal for this book in 1923. Lofting later wrote and illustrated a series of Doctor Dolittle books.

Dr. Dolittle is puzzled by the *Pushmi-Pullyu,* a two-headed beast. Chee-Chee the monkey, Dab-Dab the duck, Gub-Gub the pig, and the dog Jip are amazed, too. The illustration was drawn by Hugh Lofting, who also wrote the book *The Story of Dr. Dolittle,* published in 1920 by the J. B. Lippincott Co.

Lofting was born in Maidenhead, England, of Irish descent. He spent most of his life in the United States. He studied at the Massachusetts Institute of Technology and at the London Polytechnic, and travelled widely as a civil engineer.

Log is an instrument that measures the speed of a ship. Logs used by modern ships include (1) a tachometer; (2) the Doppler sonar speed log; (3) the pitot-static log; and (4) electronic navigation devices.

A tachometer can be used for determining the revolutions per minute (rpm) of a ship's propeller. The speed of the ship often is directly related to the propeller's rpm. Therefore, a person can use the rpm to calculate the ship's speed. However, the accuracy of this method is greatly affected by weather, by the weight of the ship's load, or by the build-up of seaweed or small shellfish called *barnacles* on the ship's underside.

On yachts and smaller ships, a device called a *knotmeter* is often used to measure speed. The knotmeter determines the distance travelled by the ship by counting the revolutions of a small paddle wheel mounted on the ship's hull. The speed of the ship can then be calculated by dividing the distance travelled by the amount of time taken.

The Doppler sonar speed log measures the apparent change in frequency of sound waves transmitted from a ship and then reflected from the bottom of the ocean. This change in frequency, or *Doppler effect,* is caused by the motion of the ship. See **Doppler effect**.

The pitot-static log operates by the action of water pressure. The basic part of a pitot-static log is a *pitot-tube,* which is mounted below the bottom of the ship. The pitot tube has an opening on the side facing the front of the ship. Another tube surrounding the pitot tube has openings that face the sides of the ship.

When the ship is at rest, the water pressure at the openings of the pitot tube and surrounding tube is the same. This is known as *static* pressure. As the ship moves, its speed increases the water pressure on the opening of the pitot tube. This additional pressure is known as *dynamic* pressure. But the openings in the outer tube still receive only static pressure. Devices inside the ship measure the differences in pressure between the tubes to determine speed and distance.

Electronic navigation devices record the course and speed of a ship relative to stationary signal transmitters. For example, *loran* involves the transmission of radio signals from two stations, known as the *master* and *slave* stations, to a ship at sea. Receiver equipment on the ship measures the time interval between the signals from the two stations. The time difference places the ship on a *loran line of position* on a chart. The ship's exact location on this line can be established by using a second loran line of position. This line is determined by measuring the time difference between signals from the master station and a second slave station. The second line will intersect the first, thereby marking the ship's location. The ship's speed can be determined by taking two readings of the ship's position, with a known interval of time between the readings. See **Navigation** (diagram: Loran).

Logs used in the past included the *chip log* and the *taffrail log.* A chip log was a thin board shaped like a quarter of a circle. A sailor threw the log into the water behind the ship, and a line attached to it unreeled as the ship moved. By noting the amount of line that ran out in a given time, a sailor could determine the ship's speed. The taffrail log consisted of a rotator with spiral fins that caused it to turn as the ship pulled it through water. The rotator was connected to a recording device that showed the distance travelled. A sailor needed to make two readings, with a known interval of time between them, to obtain the speed of the ship.

See also **Knot; Loran.**

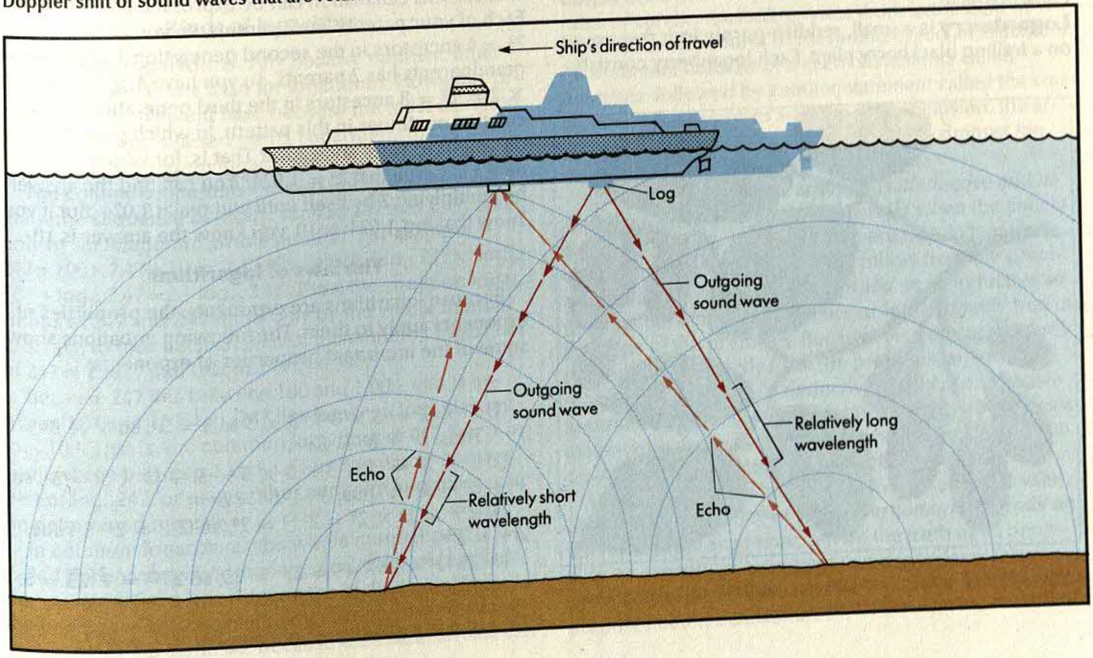
Log cabin was one of the earliest dwellings built by European settlers in North America. Log cabins served as a practical form of shelter for people who settled in forest regions and who had few tools. The log cabin became a symbol of the hardships and virtues of frontier life. Many noted Americans, including five presidents—Andrew Jackson, James Polk, James Buchanan, Abraham Lincoln, and James Garfield—proudly claimed being born in such dwellings.

The simplest log cabins were built of round logs with curved notches cut near the ends. Logs on the ground served as a foundation. Above the foundation, each log lay across the logs immediately below it and rested in their notches. In most cases, spaces between the logs were filled with stones or slats of wood and daubed tight with mud in a process called *chinking.* The roof was usually made of rough boards cut from logs.

People in Europe had been building log cabins for hundreds of years before Europeans went to America. Swedes and Finns made the first log cabins constructed in the New World. They built them beginning in about 1638 in the region near the mouth of the Delaware River. This area covered parts of what are now Delaware, New

The Doppler log

The Doppler sonar speed log is a modern navigational technique that measures speed electronically. The technique uses Doppler sonar to measure the speed of a ship by measuring the Doppler shift of sound waves that are returned from the floor of the ocean.


Ship's direction of travel
Log
Outgoing sound wave
Outgoing sound wave
Relatively long wavelength
Echo
Relatively short wavelength
Echo

Jersey, and Pennsylvania. Log cabin construction spread to many other groups of colonists, including English, Scottish-Irish, Welsh, and Dutch settlers. Eventually, log cabin construction spread to most of the wooded American frontier. In Pennsylvania in the 1700's, German-speaking colonists from Switzerland and eastern Germany made popular a more refined log carpentry. They used shaped logs and special *dovetailed* notches.

Other groups of settlers built log cabins in many parts of North America. Various types of log cabins were introduced by Russians in Alaska, French farmers in Quebec, French-Canadian fur traders in western North America, Ukrainians in the Canadian Prairie Provinces, Spaniards and Mexicans in highland areas of New Mexico, and Finns in the northern Midwest.

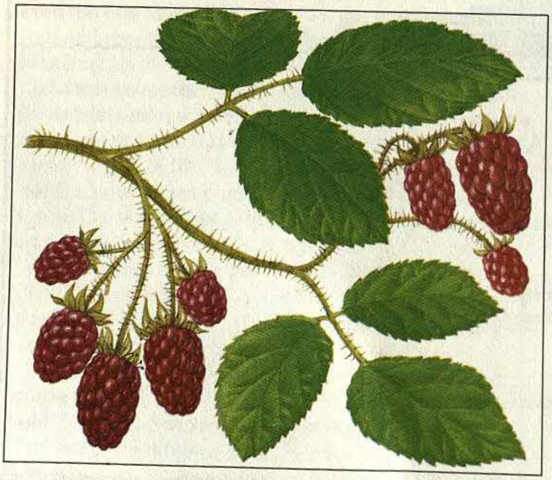
Logan, Mount. See **Mount Logan.**

Logan, Patrick (1791-1830), a British soldier, was put in charge of the Moreton Bay convict settlement in Australia in March 1825. Logan established a penal colony record by ordering convicts to be punished with more than 11,000 lashes of the whip in eight months. He maintained this brutal regime for five and a half years. Logan died in mysterious circumstances. It is believed he was killed either by convicts or by Aborigines.

Logan's treatment of the convicts seems cruel by today's standards. He carried out his duties as commandant as he was directed and in the tradition of the period. He did much to explore and open up large areas for settlement around Brisbane. Logan was born at Coldingham, Scotland.

Logan, Sir William Edmond (1798-1875), a Canadian geologist, gained fame for his pioneer work researching coal, glacial action, early fossil evidence of life, and ancient rocks. Logan was born in Montreal and educated in Scotland. During much of the 1830's, he studied coal deposits in Wales. He then returned to Canada to continue his research. In 1842, Logan became the first director of the Geological Survey of Canada. His most important book was *A Report on the Geology of Canada* (1863).

Loganberry is a small, reddish-purple fruit that grows on a trailing blackberry plant. Each loganberry consists of a cluster of tiny fruits called *drupelets.* The loganberry is probably a natural hybrid of a red raspberry and a type of blackberry called the *western dewberry.* It first appeared in California, U.S.A., in the late nineteenth century, and is widely cultivated for its large fruits. Unlike other blackberries, which grow on erect bushes, loganberries and other dewberries develop on long, willowy *brambles* (see **Bramble**). Loganberries usually are not eaten fresh because of their extremely tart flavour. Instead, they are tinned or frozen, or are made into jam, juice, or wine.



Loganberries consist of clusters of tiny fruits called *drupelets.* The berries grow on trailing vines.

Loganberries are grown commercially, particularly in parts of North America. The plants grow best in fertile, well-drained, deep soil at temperatures above −10° C. They need to have extensive irrigation for the plants to thrive and for their fruits and stems to develop properly.

Growers produce loganberry plants by burying parts of stems or roots in mounds of earth. As the plants grow, they are tied to stakes or wire frames. After the fruit is picked, growers remove the old stems to make room for new stems to develop. The plants produce fruit annually until they are about 12 years old.

Scientific classification. The loganberry plant belongs to the rose family, Rosaceae. Its scientific name is *Rubus loganobaccus.*

See also **Blackberry; Dewberry.**

Logarithms are numbers that are known in algebra as *exponents.* Exponents are used to express repeated multiplications of a single number. For example, $2 \times 2 \times 2$ can be written 2^3. In the equation $2^3 = 8$, 3 is the *exponent* and 2 is the *base.* Stated in terms of logarithms, 3 is the *logarithm* of the number 8 to the base 2. This statement can be written as $\log_2 8 = 3$. The equation $\log_2 8 = 3$ is another way of expressing $2^3 = 8$. In general, if $b^x = p$, then $x = \log_b p$.

Suppose you want to calculate the number of ancestors you have in each of three previous generations. You have 2 parents, so you have 2 ancestors in the first generation. This calculation can be expressed as $2^1 = 2$. Each of your parents has 2 parents, so you have $2 \times 2 = 2^2 = 4$ ancestors in the second generation. Each of your grandparents has 2 parents, so you have $4 \times 2 = 2 \times 2 \times 2 = 2^3 = 8$ ancestors in the third generation. The calculation continues in this pattern. In which generation do you have 1,024 ancestors? That is, for which exponent x is it true that $2^x = 1{,}024$? You can find the answer by multiplying 2 by itself until you reach 1,024. But if you know that $\log_2 1{,}024 = 10$, you know the answer is 10.

The laws of logarithms

Because logarithms are exponents, the properties of exponents apply to them. The following equations show some of the important properties of exponents:

(1) $3^2 \times 3^3 = 3 \times 3 \times 3 \times 3 \times 3 = 3^5$, so $3^2 \times 3^3 = 3^{2+3}$. Thus, $b^x \times b^y = b^{x+y}$.

(2) $3^5 \div 3^2 = (3 \times 3 \times 3 \times 3 \times 3) \div (3 \times 3) = 3^3$, so $3^5 \div 3^2 = 3^{5-2}$. Thus, $b^x \div b^y = b^{x-y}$.

(3) $(2^3)^2 = 2^3 \times 2^3 = 2^{3+3} = 2^6$, so $(2^3)^2 = 2^{3\times 2}$. Thus, $(b^x)^y = b^{xy}$.

(4) $(25^{\frac{1}{2}})^2 = 25^{\frac{1}{2}\times 2} = 25^1 = 25$, so $25^{\frac{1}{2}} = \sqrt[2]{25} = 5$.

Thus, if n is a positive whole number, $b^{\frac{1}{n}} = \sqrt[n]{b}$.

These properties of exponents can be restated as properties of logarithms:

(1) $\log_b(p \times q) = \log_b p + \log_b q$ (3) $\log_b(p^n) = n\log_b p$.

(2) $\log_b(p \div q) = \log_b p - \log_b q$ (4) $\log_b(\sqrt[n]{p}) = \frac{1}{n}\log_b p$.

To show that the first property is true, let $\log_b p = x$ and $\log_b q = y$. Then $p = b^x$ and $q = b^y$. So $p \times q = b^x \times b^y$ and $p \times q = b^{x+y}$. Since $p \times q = b^{x+y}$, $\log_b(p \times q) = x + y$. Therefore, $\log_b(p \times q) = \log_b p + \log_b q$. The other properties of logarithms can be derived in a similar way.

Using logarithms

Multiplication. To multiply two numbers using logarithms, look up the logarithms of the two numbers in a table. Add these logarithms to get the logarithm of the product of the two numbers. Then, using the table again, find the number whose logarithm is the logarithm of the product. This is the product of the two numbers.

Division. To divide one number by another, look up the logarithms of the two numbers in a table. Subtract the logarithm of the denominator from the logarithm of the numerator. Then, using the table again, find the number whose logarithm is the same as that found by this subtraction. This number is the desired quotient.

Raising a number to a power. To raise a number to a power, look up the logarithm of the number in a table. Multiply this logarithm by the exponent of the power. Then, using the table, find the number whose logarithm is the same as the logarithm found by this multiplication. This number is the desired power of the first number.

Finding a root. To find a root of a number, look up the logarithm of the number in a table, and divide this logarithm by the index of the root. Then, using the table again, find the number whose logarithm equals the number found by the division. This is the desired root of the number. See **Root; Square root.**

Kinds of logarithms

Common logarithms. Any positive number, other than 1, can serve as a base for logarithms. However, 10 is the most convenient base because the most common number system is based on 10. Logarithms to the base 10 are called *common* logarithms.

The common logarithms of two numbers that have the same sequence of digits, such as 247 and 2.47, differ only by an *integer,* or whole number. For example, $247 = 100 \times 2.47 = 10^2 \times 2.47$. Therefore, $\log_{10} 247 = \log_{10} 10^2 + \log_{10} 2.47 = 2 + \log_{10} 2.47$. Thus, the common logarithms of 247 and 2.47 differ only by the whole number 2. In fact, to four decimal places, the common logarithm of 247 is 2.3927 and that of 2.47 is 0.3927.

Because 247 lies between 100 and 1,000, that is between 10^2 and 10^3, $\log_{10}247$ lies between $\log_{10}10^2$ and $\log_{10}10^3$. That is, the common logarithm of 247 lies somewhere between 2 and 3. Thus, the whole number part of $\log_{10}247$, or of any other common logarithm, can be determined mentally.

In common logarithms, the whole number part is called the *characteristic,* and the decimal part is called the *mantissa.* For a given sequence of digits, a shift in the position of the decimal point changes the characteristic, but not the mantissa. Because the characteristic can be determined mentally, tables of common logarithms list only mantissas.

Natural logarithms. Mathematicians and scientists use *natural* logarithms in their work. In the system of natural logarithms, the base is the number $e = 2 + \frac{1}{2} + \frac{1}{2\times3} + \frac{1}{2\times3\times4} + \ldots = 2.71828\ldots$. Natural logarithms are useful in calculus because many important formulas take their simplest possible forms using them.

History

John Napier, a Scottish mathematician, published the first discussion and table of logarithms in 1614 (see **Napier, John**). Jobst Bürgi of Switzerland independently discovered logarithms at about the same time. In the early 1600's, Henry Briggs of England introduced logarithms to the base 10 and began constructing a 14-place table of common logarithms. Adriaen Vlacq of the Netherlands completed Briggs's work.

About 1622, Edmund Gunter of England conceived the idea of marking numbers on strips according to their logarithms and multiplying and dividing by sliding one strip along the other. This idea forms the basis for the slide rule.

The Briggs-Vlacq tables remained in use until 20-place common logarithm tables were calculated in Great Britain between 1924 and 1949. Today, computers and electronic calculators have eliminated the need to use logarithms for computation. However, logarithms are important for theoretical purposes.

Logbook is the official or legal written record of the events that take place during a ship's voyage. The log may be written up once a day by the captain of the ship, or it may be written by the officer in charge of each watch. It includes a record of the ship's course and speed, the weather, and any ships or lands sighted. It also records any sickness, death, or crime on board ship, and any other unusual event. See also **Log.**

Logging. See **Timber** (From forest to sawmill).

Logic is a branch of philosophy that deals with the rules of correct reasoning. Most work in the field of logic deals with a form of reasoning called an *argument.* An argument consists of a set of statements called *premises,* followed by another statement called the *conclusion.* If the premises support the conclusion, the argument is correct. If the premises do not support the conclusion, the argument is incorrect.

There are two types of arguments, *deductive* and *inductive.* A deductive argument is *valid* when the conclusion must be true if the premises are true. When the conclusion does not necessarily follow from the premises, a deductive argument is *invalid.* In an inductive argument, the conclusion is more or less probably true on the basis of the premises. Because the conclusion does not follow necessarily from the premises, an inductive argument is not usually deductively valid. An inductive argument may be correct or incorrect. This article deals mainly with deductive reasoning. For more information on inductive reasoning, see **Inductive method.**

Logic tells us whether a deductive argument is valid or invalid. The validity of such an argument depends on the form of the argument, not on the truth of its premises. As a result, an argument that depends on false premises could be valid, and an argument based on true premises could be invalid.

The categorical syllogism is the most common form of argument in traditional deductive logic. The ancient Greek philosopher Aristotle was one of the first scholars to carry out a systematic study of the categorical syllogism.

A syllogism consists of two premises and a conclusion. A categorical syllogism is one in which every statement has one of the four forms: (1) All A are B. (2) No A are B. (3) Some A are B. (4) Some A are not B. The letters A and B, or any other letters that might be used, are terms that represent various classes of things, such as numbers, people, yellow objects, unpleasant sounds, or brown cows. The following argument is an example of a valid categorical syllogism: "All mammals are warm-blooded. All brown cows are mammals. Therefore, all brown cows are warm-blooded." The form of this syllogism is: "All A are B. All C are A. Therefore, all C are B."

The following categorical syllogism is invalid: "No stars are planets. Some satellites are not planets. Therefore, some satellites are not stars." This syllogism has the following form: "No A are B. Some C are not B. Therefore, some C are not A." We can determine that this syllogism is invalid by comparing it with another syllogism that has the same form and yields a false conclusion. Such a syllogism would be: "No precious stones are cheap things (true). Some diamonds are not cheap things (true). Therefore, some diamonds are not precious stones (false)." This syllogism fails to meet the requirement that the conclusion must be true if the premises are true. Therefore, the syllogism must be invalid.

The rules of syllogisms enable us to test a categorical syllogism without considering similar examples or examining the argument's structure in detail. These rules are based on certain features that occur in all valid syllogisms and distinguish them from invalid ones. For example, one rule states that no valid syllogism has two negative premises. There are two negative premises in this syllogism: "*No* stars are planets. Some satellites are *not* planets. Therefore, some satellites are not stars." Thus, we know that this syllogism cannot be valid.

There are other rules for constructing valid syllogisms. (1) The syllogism must have exactly three terms. For example, consider this invalid syllogism: "All laws are made by governments. $v=at$ is a law of falling bodies. Therefore, governments made $v=at$." The term *law* is unclear. It can refer to a physical law, such as the law of falling bodies, or to legislative law. As a result, this syllogism has four terms instead of three—and is invalid. (2) Two positive premises must yield a positive conclusion. (3) A negative premise and a positive premise must yield a negative conclusion. (4) The term that occurs in both premises must be modified by the words *all* or *none* at least once. (5) A term that is modified by *all* or *none* in the conclusion must be modified by *all* or *none* in one of the premises.

Modern logic extends far beyond the work of Aristotle. Modern *logicians* (scholars who study logic) have developed theories and techniques to deal with deductive arguments other than categorical syllogisms. Notable modern logicians include the British mathematicians George Boole and Alfred North Whitehead and the British philosopher Bertrand Russell. These logicians, unlike traditional ones, have used mathematical methods, as well as techniques that involve symbols.

Today, logic is used mainly to test the validity of arguments. It also has important uses in working with such devices as computers and electric switching circuits.

To test an argument, a logician first analyses its statements and expresses them as symbols. In many cases, a letter or other character in an argument stands for a whole word or phrase. For example, logicians would write the sentence "Socrates is wise" as "Ws." The sentence "Every Greek is wise" would be written as a formula: "$(x)\ (Gx \rightarrow Wx)$." The $\rightarrow$ means *if* ________, *then* ________. Next, the logician uses *rules of derivation,* also called *inference rules,* to determine what new formulas may be derived from the original premises. For example, one rule enables the statement "Q" to be derived from the statements "P" and "$(P \rightarrow Q)$." Thus, the statement "The picnic is cancelled" may be derived from "It is raining" and "If it is raining, then the picnic is cancelled." The logician continues to derive formulas until a conclusion has been reached.

Special uses of logic. Special branches of logic guide much reasoning in science, law, and certain other fields. Various branches of logic guide reasoning involved in obligations, promises, commands, questions, preferences, and beliefs.

Much of the reasoning that people do in everyday life is nondeductive—that is, it produces probable conclusions rather than definite ones. For example, doctors use nondeductive reasoning in diagnosing the probable cause of a patient's symptoms. Legal scholars often use nondeductive methods to determine what law governs a particular case.

Related articles in *World Book* include:

Aristotle
Deductive method
Fallacy
Russell, Bertrand
Science (Mathematics and logic; Using logic)
Set theory (In logic)
Truth table
Whitehead, Alfred North

Logistics is the practical art of providing and maintaining soldiers, equipment, and supplies for military operations. Modern armies armed with complex weapons and equipment require tremendous logistical effort to put them into battle and keep them there. For example, almost half the total strength of the United States Army in World War II (1939-1945) had to provide logistic support for the other half that came in direct contact with the enemy. One out of four men in a combat division performed duties related to logistics, such as supply and administration.

The extraordinary task of supplying an army can be imagined by comparing the amounts of artillery ammunition fired in World War I (1914-1918) and in the American Civil War (1861-1865). During one average month of World War I, the British and French armies fired more than twice as much artillery ammunition as did the Union army during the entire Civil War.

Supply forms only one part of the task of logistics. Military forces must be moved from place to place. They must have lodging, food, and medical care. Records on the fighting forces must be kept.

On land and in the air, chemical, engineer, medical, ordnance, quartermaster, signal, and transportation units provide logistic support for combat units. At sea, cargo ships, hospital ships, icebreakers, minelayers, oiltankers, repair ships, transports, and tugs provide this support to warships.

Logrolling. See **Birling.**

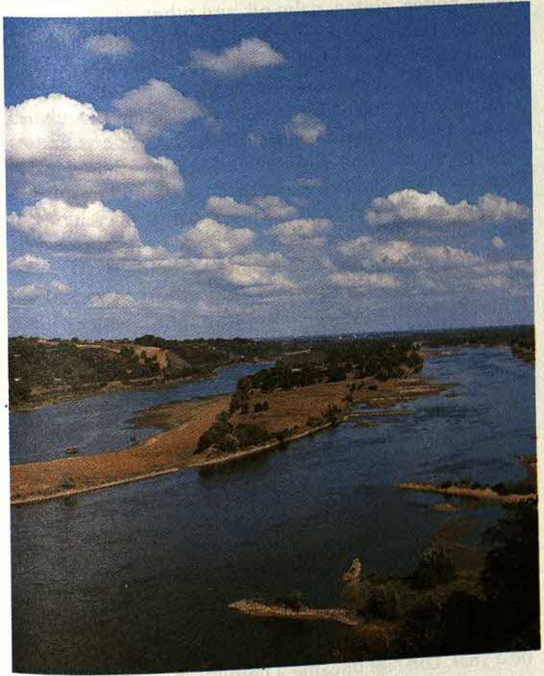
Logwood comes from the core of a tree belonging to the pea family. The tree grows in tropical regions of Central America, Mexico, South America, and the West Indies. Its heartwood is bright orange. When exposed to air, however, it changes to red and finally reddish-black. The wood is very hard and heavy. It is called *logwood* because it is shipped to market in log form.

Logwood is used mainly to make dyes, stains, and manufacturing inks. By boiling logwood chips in water, workers extract a substance called *haematoxylin.* This substance forms an orange-red solution with the water. Dyes that are also referred to as logwood can be turned lighter shades of red by adding acids. They can be produced in black or in darker shades of red, blue, or purple by adding alum and alkalis.

Scientific classification. Logwood belongs to the pea family, Leguminosae (Fabaceae). It is *Haematoxylon campechianum.*

See also **Belize City.**

Loire River is the longest river in France. It is about 1,050 kilometres long, and it drains about a fourth of the country. For location, see **France** (physical map). The Loire rises in the Velay Mountains, about 1,370 metres above sea level, and flows northward to Orléans. At Orléans, it turns westward and flows through the Loire Valley, which is known for its many *châteaux* (large country houses). It empties into the Bay of Biscay in western France. The river was an important navigable waterway in the past, but large, modern boats find it difficult to sail on the Loire because of occasional floods and many sandbanks. The wide mouth of the river at St.-Nazaire has been deepened by dredging from Nantes to the sea. Canals connect the Loire with the Saône, Rhône, and Seine rivers. The Loire's most important tributaries are the Allier, Cher, Indre, Maine, and Vienne rivers.



The Loire Valley is famous for the fine wines produced from the many vineyards in the region.

Loke Wan Tho (1915-1964) was a well-known Malaysian-born photographer, art patron, and *ornithologist* (a person who studies birds). He was an associate of the British Royal Photographic Society and of the Photographic Society of America. He headed the Cathay Organization, which owned numerous cinemas and film studios in Southeast Asia. He was a philanthropist, who contributed generously to education and medicine.

He was born in Kuala Lumpur, Selangor, in what is now Malaysia. He had his early education at the Victoria Institution. In 1929, he joined Chillon College in Switzerland. In 1933 he continued his studies at Cambridge University and the London School of Economics in the United Kingdom. He returned to Malaya in 1938.

Loke Yew (1845-1917) was a Chinese-born Malayan businessman and philanthropist. He gave generously to hospitals, schools, and many charities. In 1912, he contributed money to establish the University of Hong Kong. A statue of Loke Yew stands in the main hall of the university.

Loke Yew was born in Kwangtung province, in South China. His family were poor farmers. He went to Singapore in 1858 at the age of 13. He worked in a shop for four years and saved enough money to start up his own business. Loke Yew made a fortune out of Malaya's booming tin industry. He was also deeply involved in farming investments, land ownership, banking, and transportation. By the time he died, Loke Yew was the leading Chinese businessman in British Malaya.

Loki was a god of Norse mythology who was known as a troublemaker and trickster. He was the son of a giant but lived among the gods, who were the enemies of the giants. Most stories of Loki portray him as evil, though some myths tell of occasions when he helped the gods. Loki could change his shape at will, and he often appeared as an old woman or an animal.

The principal myth about Loki concerns his role in the murder of Balder, the handsome son of Odin, the chief god. Loki was jealous of Balder's beauty and popularity. Balder could be killed only by mistletoe, and so the gods made a sport of throwing things at him because he would not be hurt. One day, when the gods were amusing themselves in this way, Loki handed the blind god Hoder a sprig of mistletoe. Loki helped the unknowing Hoder aim the branch and throw it at Balder. The mistletoe pierced Balder's body and killed him.

When the gods learned what Loki had done, they sentenced him to be chained across three rocks, with a snake dripping poison onto his face. His devoted wife, Sigyn, caught the drops of poison in a bowl. But each time the bowl filled up and she left to empty it, the venom struck Loki and made him twist in agony.

According to legend, Loki will remain chained until the time of a battle called *Ragnarok.* He will then break free and lead the giants in an attack on the gods. The world will be destroyed in this battle, and all the gods and giants will die.

See also **Balder.**

Lollards were followers of the English religious reformer John Wycliffe. Lollardism developed as a religious movement in the 1380's. The Lollards preached obedience to God, reliance on the Bible as a guide to Christian living, and simplicity of worship. They rejected the richness of the Mass, most sacraments, and the supremacy of the pope. They denied that an organized church was necessary for salvation. Most Lollards were poor priests or people who were not members of the clergy. They wore long russet gowns, carried staffs, and lived on what they could beg. Henry IV of England, who became king in 1399, persecuted the Lollards because their views disagreed with religious law. But despite persecution, the movement gained many followers among the common people. The movement began to lose support after 1420.

The Lollards had little permanent effect on religious life in England, but they had great influence in Bohemia. There, John Hus was burned at the stake in 1415 for preaching Wycliffe's doctrines. One hundred years later, Martin Luther embraced some of Hus's ideas. In this way, the Lollards helped to pave the way for the Protestant Reformation.

See also **Wycliffe, John; Hus, John.**

Lombard, Peter (1095?-1160), was a medieval theologian who wrote an important theological textbook, *The Four Books of Sentences.* It was completed by 1158, and served as a standard textbook in theological schools for 300 years.

In the *Sentences,* Lombard presented past and current opinions on theological problems in a systematic way. He compiled these opinions from a number of leading church authorities, especially Saint Augustine. Lombard also summarized the church's position and wrote his own views on the issues. For centuries, students of theology were required to comment on the *Sentences.* Some of these commentaries were the major works of leading medieval theologians and philosophers, including Saint Bonaventure, John Duns Scotus, and William of Ockham.

Lombard was born near Novara, Italy, and studied in Bologna. About 1134, he went to Paris and taught in the cathedral school of Notre Dame. Lombard quickly gained fame as a theologian and author. In 1159, he was appointed bishop of Paris.

See also **Scholasticism** (The scholastic method).

Lombardi, Vince (1913-1970), was one of the most successful coaches in American professional football history. Lombardi was known for his demanding attitude toward his players and for his philosophy of hard work, dedication, and pride.

Lombardi had his greatest success coaching the Green Bay Packers of the National Football League (NFL) during the 1960's. He became head coach and general manager of Green Bay in 1959. In his nine years as head coach, the Packers won five NFL titles. They also won the first two Super Bowls, in 1967 and 1968.

Vincent Thomas Lombardi was born in New York City. He played football at Fordham University from 1934 to 1936. Lombardi was a coach at Fordham in 1947 and 1948 and at the U.S. Military Academy from 1949 to 1953. He served as offensive coach for the NFL's New York Giants from 1954 to 1959. Lombardi retired as Green Bay head coach in 1968. From 1969 until his death, he served as head coach, general manager, and part owner of the Washington Redskins.

Vince Lombardi

Lombards were members of a Germanic tribe that conquered much of Italy in the late A.D. 500's, and threatened the political power of the popes.

The Lombards probably came from Gotland Island in the Baltic Sea. They migrated to northern Germany along the lower Elbe River in the 100's B.C. In the A.D. 300's, they began to move southward. By about 490, they had settled in what is now Austria. The Lombards invaded Italy in 568 and seized control of much of the Italian peninsula. They settled in a part of northern Italy that is still called *Lombardy.*

The popes in Rome feared the Lombards would destroy their political power. In 754, Pope Stephen II asked the Franks for help. Pepin the Short, the Frankish king, invaded Italy and defeated the Lombards. Pepin gave part of central Italy to the pope in 756. In 774, Charlemagne, Pepin's son, crushed the Lombards. As a result, the Franks won control of Italy and the popes' power remained secure.

Lombardy is a region in northern Italy. It is named after the Lombards, a tribe that once lived there. Lombardy has a population of 8,898,653, and an area of 23,842 square kilometres. It includes the provinces of Bergamo, Brescia, Como, Cremona, Mantova, Milano, Pavia, Sondrio, and Varese. Lombardy, Italy's chief industrial region, produces much wine, silk, and cheese. Milan is the capital. See also **Lombards; Milan.**

Lomé (pop. 366,476) is the capital and largest city of Togo. It lies in southwest Togo on the Gulf of Guinea, an arm of the Atlantic Ocean. For location, see **Togo** (map).

Lomé's port serves as the main outlet for Togo's cocoa, coffee, cotton, palm oil, and other products. In addition, Lomé is a popular tourist destination. The city features a lively open-air market, sandy beaches, and luxury hotels. Lomé has an international airport.

Lomé was a small village until 1897, when it became the capital of German Togo. In 1919, Lomé came under French control. After Togo gained independence from France in 1960, Lomé expanded its port, built new hotels, and became the site of Togo's only university.

Lomond, Loch. See **Loch Lomond.**

Lon Nol (1913-1985) headed the government of Cambodia from 1970 to 1975. He and other leaders overthrew Prince Norodom Sihanouk because they opposed his friendly policy toward Communists in Vietnam. Lon Nol declared Cambodia a republic later in 1970, but he soon began to rule as a dictator. He suffered a stroke in 1971 and gave up many of his duties. But in 1972, he set up a new government with himself as president.

Cambodia became involved in the Vietnam War during the early 1970's. Cambodian government troops fought Communist rebels. Lon Nol fled to the United States in 1975, shortly before his government surrendered to the Communists. See **Cambodia** (History).

Lon Nol was born in Prey Veng Province in Cambodia when the country was a French colony. He joined the army in 1952, and Cambodia gained independence the next year. Lon Nol became a lieutenant general in 1961. He was minister of defence from 1955 to 1966, and prime minister from 1966 to 1967 and 1969 to 1972.

The landmarks of London include the statues of Trafalgar Square, *foreground,* and the Clock Tower of the Houses of Parliament, *background,* from which Big Ben booms out the hours.

St. Paul's Cathedral, *right,* towers over London's oldest section, *the City.* The City began about A.D. 43 as a Roman trading post on the River Thames. It is now London's financial centre.

Colourful ceremonies take place in London today just as they have for hundreds of years. These troops of the queen's Household Cavalry are changing the guard at Horse Guards Parade.

London

London is the capital of the United Kingdom of Great Britain and Northern Ireland. It ranks as one of the world's oldest and most historic cities. London traces its history back nearly 2,000 years.

Each year, millions of tourists visit London to see such historic sights as Buckingham Palace, Westminster Abbey, and the Tower of London. Buckingham Palace has long been the London home of Britain's monarchs, including the present queen, Elizabeth II. The nation's kings and queens are crowned in Westminster Abbey, one of London's several magnificent churches.

London is a large, lively city as well as a historic one. It is one of the largest cities in the world. London's banks, insurance companies, and shipping firms do business in almost every country.

London grew up around two old, historic cities—the City of London and the City of Westminster. The City of London started as a trading post of the Roman Empire about A.D. 43. The City of Westminster began as a residence for England's rulers about 1,000 years later. It stood about 3 kilometres southwest of London. A great stone wall surrounded the City of London. But as London grew, it spread far beyond its wall and took in the royal City of Westminster.

Today, the area where Roman London stood is still known as the City of London. It and the City of Westminster lie at the heart of modern London and make up most of its busy central area. Central London has tall office blocks, busy streets crowded with shoppers, as well as outstanding museums, art galleries, theatres, and beautiful parks. The rest of London extends 19 to 31 kilometres in every direction from this central section.

Greater London

The City of London and the communities surrounding it form the area called *Greater London* or simply *London.*

London covers 1,580 square kilometres in southeast England, one of the four countries that form the United Kingdom. The River Thames flows generally eastwards through the heart of London. Away from the low, flat or rolling areas near the river, the land becomes hilly. The Thames empties into the North Sea about 64 kilometres east of London. The river thus links London with shipping routes throughout the world. London was once in danger of flooding caused by surge tides, when high tides and storms raise the level of the water in the North Sea. The Thames flood barrier at Woolwich, completed in 1982, now provides protection against such floods.

London is divided into 32 *boroughs* (local units of government) plus the old City of London, often simply called *the City.* The City and each borough have their own governments.

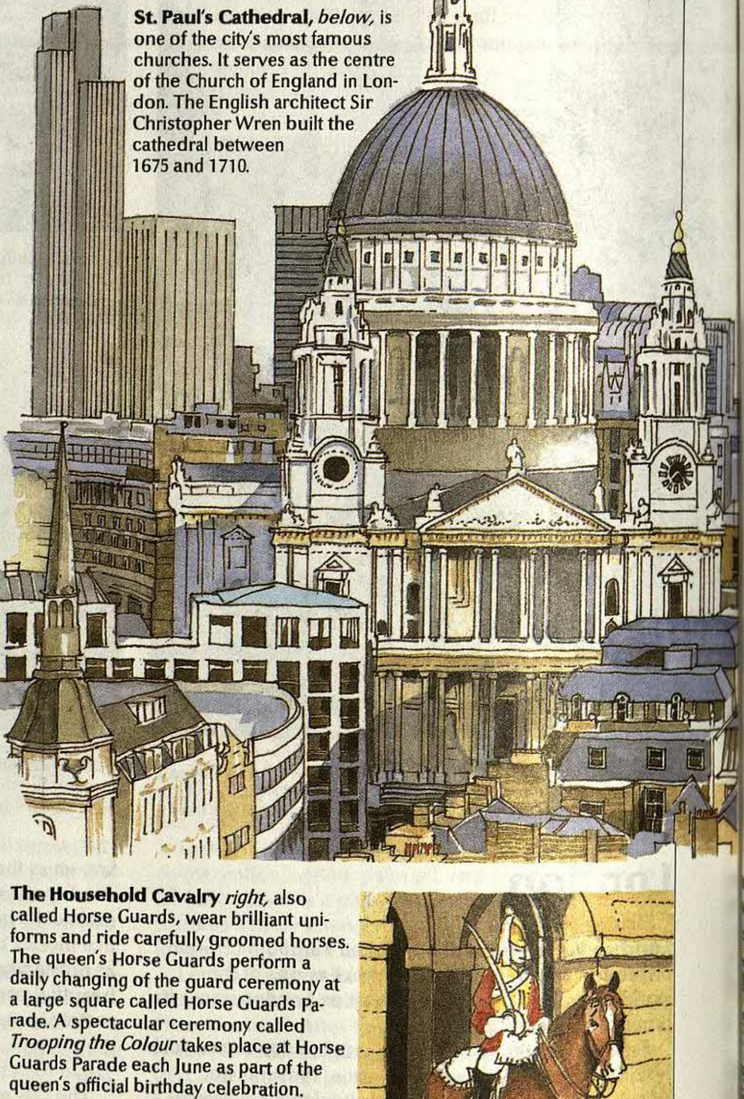
London *One of the world's great cities: a seat of history and culture.*

Capital of United Kingdom of Great Britain and Northern Ireland. Tenth largest city in world—almost 6½ million people.

One of world's oldest cities. Each year, millions of tourists visit its many historic sights. Outstanding museums, art galleries, theatres.

Chief economic centre of Great Britain. Great world port and centre of trade. Leading industries include manufacture of clothing, food products, furniture, and precision instruments; printing and publishing. Bank of England one of several important financial institutions.

St. Paul's Cathedral, *below,* is one of the city's most famous churches. It serves as the centre of the Church of England in London. The English architect Sir Christopher Wren built the cathedral between 1675 and 1710.



The Household Cavalry *right,* also called Horse Guards, wear brilliant uniforms and ride carefully groomed horses. The queen's Horse Guards perform a daily changing of the guard ceremony at a large square called Horse Guards Parade. A spectacular ceremony called *Trooping the Colour* takes place at Horse Guards Parade each June as part of the queen's official birthday celebration.

Lloyd's of London, *left,* is a world-famous insurance society that originated in about 1690. The firm's headquarters, a modernistic building designed by architect Richard Rogers, was completed in 1986. Much of the structure is glass, so light streams into the central atrium and tiers of galleries inside.

A.D. 43
London founded as a seaport by Romans, who named port *Londinium.*

410
Roman control ended. Barbarians invaded Rome.

Mid-1000's
City of Westminster began to be built as residence for England's rulers.

1209
London Bridge completed; first stone bridge across Thames.

1599
William Shakespeare began to present his plays at Globe Theatre about this time.

1666
Great Fire of London raged for five days, destroyed thousands of buildings.

Buckingham Palace, official royal residence since 1837. Most former palaces, including Kensington Palace and the Banqueting House of Whitehall Palace, now museums or showplaces. Crown jewels on display at Jewel House of Tower of London.

The Tower Bridge, *above,* opened in 1894. It used to lift open several times a day to allow ships to pass through, but nowadays openings are rare. The high walkways across the top of the bridge provide a splendid view of the city.

Number 10 Downing Street, *above,* has been the official home of the prime minister of Britain since 1732. Sir Robert Walpole (1676-1745) was the first prime minister to live there.

Trafalgar Square, *below,* is one of London's most famous squares. On the left is the National Gallery, a vast collection of paintings that includes many masterpieces. On the right is St. Martin-in-the-Fields, an elegant church completed in 1726. The Academy of St. Martin-in-the-Fields, an orchestra known internationally, was founded there.

1700's
London Stock Exchange operated in coffee houses until 1773. London's newspaper industry grew up in Fleet Street area coffee houses.

1800's
Industrial Revolution spread; many factories sprang up in London.

1863
London's underground passenger railway system started—first in world.

1940, 1941
London air attacks by Germany took place during World War II.

1960's
Skyscrapers went up in central London, changing skyline dramatically.

Central London covers about 26 square kilometres on both sides of a great north-south bend in the River Thames. It includes the busiest parts of London.

Central London can be divided into three main sections. They are: (1) the City, (2) the West End, and (3) the South Bank. The City and the West End lie on the north side of the Thames. The South Bank lies across the river from these areas.

The City forms London's famous financial district. The City covers about 2.6 square kilometres at the eastern edge of central London. Only about 5,000 people live in the City. But almost half a million office workers crowd its buildings and streets each working day.

The City is the oldest part of London. It stands where the walled City of London stood for hundreds of years. The City consists largely of modern bank and office buildings. But it also has some reminders of its colourful past. The great dome of St. Paul's Cathedral, for example, still stands as a monument of inspiration and power. Parts of the Guildhall date from the 1400's. This building has long served as the City's administrative centre. Mansion House, the home of the City's lord mayor, dates from the mid-1700's. A 62-metre stone column called the Monument stands near the spot in the City where the Great Fire started in 1666.

The West End is the centre of Britain's government and London's retail trade and night life. It is also London's most fashionable residential area.

The West End covers about 18 square kilometres just west of the City. Near the River Thames, a street called the Strand links the West End and the City.

Britain's chief government buildings are in the City of Westminster. The Houses of Parliament, perhaps the best known government buildings, tower dramatically along the Thames. From Parliament, the government buildings extend northward along a broad avenue called Whitehall. Number 10 Downing Street, which is the home of Britain's prime minister, is located just off Whitehall. Buckingham Palace lies a short distance to the southwest of the prime minister's home.

London's main shopping and entertainment districts spread out from two huge West End street junctions. One, Trafalgar Square, is an area of open pavement with statues and fountains. Whitehall, the Strand, and streets from the upper West End meet at the square. At the other, Piccadilly Circus, six busy streets come together. Many of London's finest shops are in this area, along Bond, Oxford, and Regent streets. Piccadilly Circus also forms the centre of London's largest entertainment area. The area extends eastward to the Strand and northward into Soho, a district of restaurants and nightclubs.

The South Bank is the site of a large, modern cultural centre with theatres, concert halls, and art galleries.

The South Bank covers about 5 square kilometres along the inside curve of the River Thames. The South Bank section grew more slowly than the City and West End. But the cost of land in the City and West End has forced builders to find cheaper sites across the river.

Outlying areas. Crowded residential neighbourhoods surround most of central London. Numerous small factories are mixed in with the houses in many of these communities, especially in the area known as the *East End*. The East End includes most of the borough of Tower Hamlets and part of the borough of Hackney.

Facts in brief about London

Population: *1991 census*—6,378,600.
Area: 1,580 km².
Climate: *Average temperature*—January, 4° C; July, 17° C. *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—61 cm. For the monthly weather in London, see **United Kingdom** (Climate).
Government: Thirty-two borough governments, each consisting mainly of elected councils and headed by a mayor; and the City of London government made up of the lord mayor, 24 aldermen, and 136 common councilmen.
Founded: *City of London*—about A.D. 43.

People

London is so large that many Londoners think of themselves mainly as residents of a particular district, such as Chelsea, Soho, or Hampstead. The various districts were once separate communities, and many have kept their special character.

Ancestry and religion. According to tradition, the only "real" Londoners are *cockneys*. A cockney is anyone born within hearing distance of the bells of St. Mary-le-Bow, a historic church in the City. But cockneys are better known for their accent. (See **Cockney**).

Most Londoners come from a long line of British-born ancestors. But over the years, London has attracted many new residents from outside the UK. Today, about a million Londoners are immigrants. Many others are the children or grandchildren of immigrants. Areas bordering the West End have many immigrants from Australia, India, Pakistan, Poland, and the West Indies. London has long had a large Jewish population.

The people of London belong to a variety of religious faiths and Christian denominations. They include members of the Church of England or other Protestant churches, members of the Roman Catholic Church, and adherents of the Jewish, and Islamic faiths.

Residential areas and housing. Most Londoners live in suburban communities in the *outer boroughs*. These boroughs, such as Barnet, Croydon, Havering, and Hounslow, lie farthest from central London.

London's oldest and most crowded residential areas lie in the *inner boroughs*. These boroughs, such as Hammersmith, Islington, Southwark, and Tower Hamlets, immediately surround the City and West End. Most of London's poor families and immigrants live in rented houses and flats in these boroughs. But some parts of these boroughs have become fashionable.

The chief exceptions to low-class housing in the inner boroughs are in the City of Westminster and the borough of Kensington and Chelsea. Westminster includes most of the West End. Many of London's richest families live in expensive flats in Westminster, especially in the fashionable Mayfair district. This prosperous section extends northwestward to the Hampstead district in the borough of Camden, which has many expensive houses. The City has few homes or flats, except for a large housing development, called the Barbican, built in the 1960's and 1970's.

Education. Most schools are state owned and operated. Each of London's boroughs runs its own schools. London has several *public schools,* which, despite their name, are private schools. They include Harrow, St. Paul's, and Westminster. London has long been Britain's chief centre for advanced study and research. The University of London is the nation's largest traditional university (see **London, University of**).

Recreation. During the day, many Londoners enjoy going to colourful street markets, which sell everything from fresh fruit and vegetables to bargain jewellery and antiques. Popular street markets include Petticoat Lane (Middlesex Street) market, at the eastern edge of the City; Berwick Street market, in Soho; and Portobello Road market, near Kensington Gardens.

London's most popular spectator sport is association football. Several professional teams play in leagues from August to April. Major matches, such as cup finals and internationals, are played at Wembley Stadium, which seats about 80,000 spectators (see **Football, Association**). Rugby Union is also popular. The season lasts from September to April. International rugby matches are held at the Twickenham Rugby ground in the borough of Richmond upon Thames. See **Rugby football** (Rugby Union).

Cricket is played in spring and summer. Lord's cricket ground, just west of Regent's Park, is the headquarters of world cricket. The Oval, in the borough of Lambeth, is another historic cricket ground. See **Cricket**.

Londoners also enjoy such sports as golf, horse racing, and tennis. The Crystal Palace National Sports Centre, in the borough of Bromley, has facilities for athletics and many other sports. The annual All-England (Wimbledon) Championships, probably the most famous tennis tournament in the world, takes place in late June and early July at Wimbledon Park, in the borough of Merton. London has more than 2,300 licensed betting shops, where people bet on various sports events.

In the evening, many people enjoy a visit to one of the city's many cinemas or theatres. Others meet their friends in their neighbourhood pub (public house). London also has many private and public clubs.

Social problems. Like most other large cities throughout the world, London has such problems as poverty, homelessness, crime, and drug addiction.

In several of the poorer boroughs, unemployment among young people is widespread. Many young people turn to shoplifting or more serious crimes. Some also begin to experiment with drugs.

In the 1960's, London's housing authorities moved thousands of poorer families to the new towns outside London. They also replaced much inadequate housing with modern flats. But housing remains a serious problem in the inner boroughs.

Cultural life and places to visit

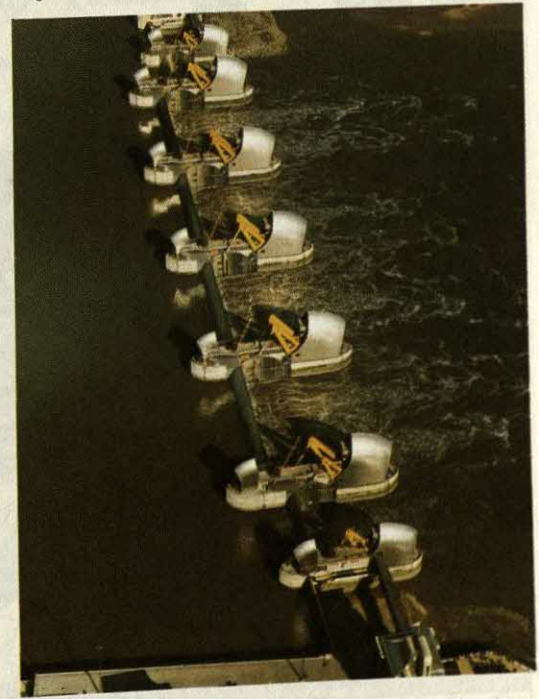
Arts. London is one of the world's leading cultural centres. It has many theatres, whose productions range from musical comedies to the plays of William Shakespeare. Britain's Royal National Theatre Company performs in three theatres on the South Bank. The Barbican Centre in the City houses the Royal Shakespeare Company when it performs in London. This company also stages plays in Stratford-upon-Avon.

London is home to a number of world-famous symphony orchestras, including the BBC (British Broadcasting Corporation) Symphony, London Philharmonic, London Symphony, Philharmonia, and Royal Philharmonic. Most major concerts are held in the Royal Festival Hall, the Queen Elizabeth Hall, or the Purcell Room, which are part of the South Bank cultural centre, or in the Barbican Centre. The Royal Albert Hall, an older concert hall near Kensington Gardens, has a popular series of summer BBC concerts called "the Proms." Britain's national ballet and opera companies perform at the Royal Opera House, at Covent Garden, near the Strand.

London's public art galleries include the National Gallery, Trafalgar Square; the Tate Gallery, in Westminster; and the Wallace Collection, housed in a mansion south of Regent's Park. Important visiting art exhibits are held at the Royal Academy of Arts, just west of Piccadilly Circus, and at the Hayward Gallery, a part of the South Bank cultural centre.

Museums and libraries. The British Museum, near the West End, is one of the world's most famous museums. It houses a priceless collection of objects from ancient civilizations. The library was formerly operated as part of the museum. But in 1973, it became part of the newly formed British Library. See **British Library; British Museum.**

Other famous museums in London include the Victoria and Albert Museum, which has one of the world's largest collections of decorative art; the Natural History



The Thames Flood Barrier was built to prevent flooding in London. When a very high tide is due, the gates are raised to keep water from flowing upstream and engulfing the city.

Museum; and the Science Museum. The Museum of London is in the City of London.

Palaces. Over the centuries, the Royal Family have lived in a number of splendid palaces in London. St. James's Palace, between St. James's Park and Green Park in the West End, was the official royal residence from 1698 to 1837. Buckingham Palace has been the official royal residence since 1837. Other London palaces include Kensington Palace in Kensington Gardens and Hampton Court Palace in Kingston upon Thames.

The Houses of Parliament, in Westminster, serve as the meeting place of the United Kingdom's two legislative bodies, the House of Commons and the House of Lords. The buildings are officially called the New Palace of Westminster. They were constructed during the mid-1800's to replace the old palace buildings, which had burned down in 1834. Big Ben, the huge bell in the Clock Tower, has boomed out the hours since 1859. During World War II, German bombs damaged the House of Commons. It was rebuilt after the war. See **Big Ben; Parliament** (The United Kingdom Parliament).

The chief survivor of the 1834 fire was Westminster Hall, an assembly hall completed in 1099 and remodelled during the late 1300's. It stands near the centre of the Houses of Parliament.

Churches. St. Paul's Cathedral and Westminster Abbey are the most famous churches in London. St. Paul's serves as the centre of the Church of England in London. The great English architect Sir Christopher Wren built the church between 1675 and 1710 to replace the original St. Paul's, which was destroyed in the Great Fire of 1666. The church's huge dome towers 111 metres high. Wren also rebuilt more than 50 other churches destroyed or damaged in the Great Fire.

The history of Westminster Abbey reaches back more than 900 years. In 1066, William the Conqueror was

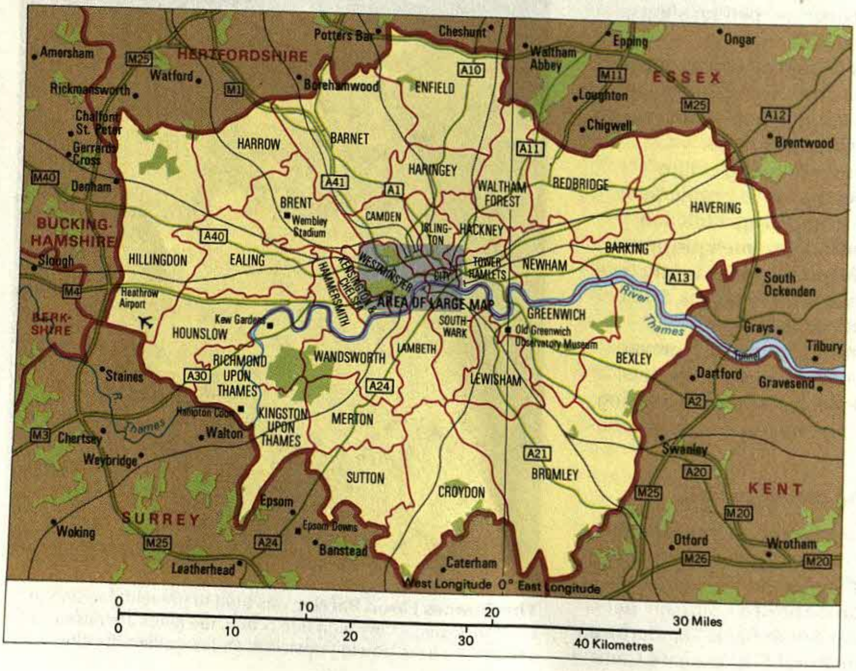
London

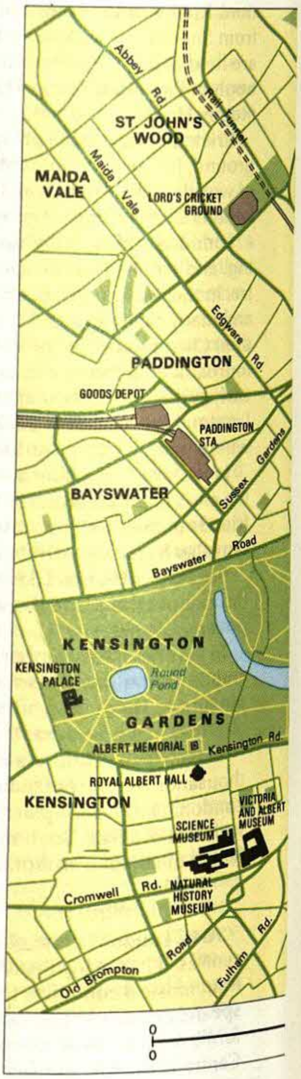
London, one of the world's largest cities, lies on the River Thames in southeastern England. It is a world centre of trade, finance, government, and the arts. Greater London, shown below, includes the old City of London at the centre and the 32 London boroughs. Many familiar landmarks of historic interest appear on the large map of central London on the right.

🟨 Greater London
🟫 Counties surrounding Greater London
🟩 Park or forest
🟦 Water

County boundary
Borough boundary
M1 Motorway
Other road or street
Railway and station
Point of interest
• City or town

Greater London





crowned king there. Since then, almost all the country's monarchs have been crowned in Westminster Abbey. The church has been added to and remodelled over the centuries, but some of its present architecture dates from the 1200's. See **Westminster Abbey.** Nearby is Westminster Cathedral, England's chief Roman Catholic church, which was completed in 1903.

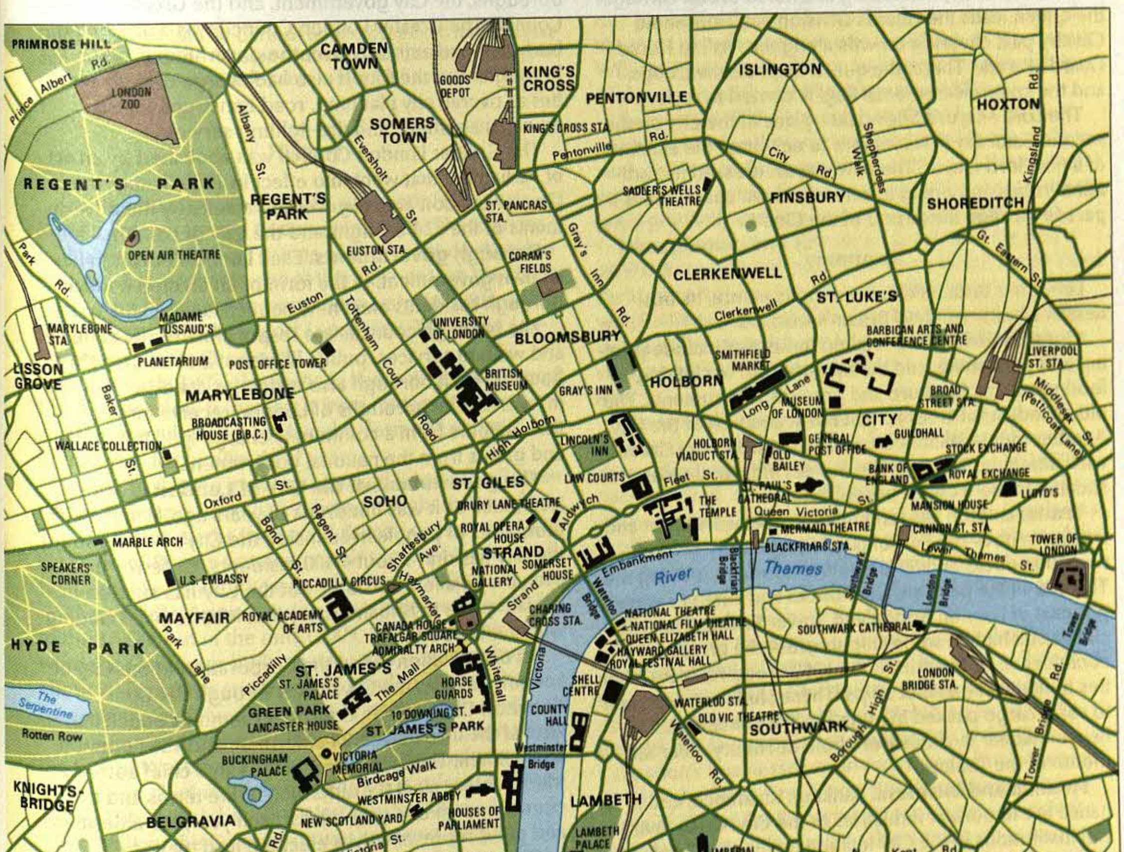
Squares. Much of London's West End is laid out around a series of squares. The best-known square is Trafalgar Square. The huge Nelson Column towers 52 metres above the square. It consists of a tall granite column topped by a giant stone statue of the British naval hero Horatio Nelson. Other well-known squares include Bedford, Berkeley, Grosvenor, and Russell squares.

Parks. London's largest parks are the *royal parks.* These parks once formed part of royal estates but are now set aside for public use. Central London has five royal parks: St. James's Park, Green Park, Hyde Park, Kensington Gardens, and Regent's Park. Hyde Park is famous for its Speakers' Corner, just south of Marble Arch.

More than 80 other public parks lie in or near central London. Battersea Park, in the borough of Wandsworth, offers a variety of attractions, including a popular amusement park. Kew Gardens, also called the Royal Botanic Gardens, contain one of the world's largest collections of tree and shrub species and hothouse plants.

Other places of interest. The Tower of London, which borders the City in the borough of Tower Hamlets, is London's oldest landmark. It consists of a group of structures built around a central tower, called the White Tower, and surrounded by two stone walls. The White Tower dates from the late 1000's. See **Tower of London.**

The Inns of Court are Britain's centre for the study and practice of law. They consist of four groups of buildings and courtyards west of the City. See **Inns of Court.**



Some places of interest lie outside central London. For example, the borough of Greenwich has a famous group of buildings designed by Wren for the Greenwich Hospital in the late 1600's. They now house the Royal Naval College.

Ceremonies. Guards, usually red-coated sentries of the Guards Division, stand watch at Buckingham Palace. Each morning, the famous changing-of-the-guard ceremony takes place in the palace's front courtyard. The royal Household Cavalry also holds a daily changing of the guard at Horse Guards Parade, a parade ground next to the Horse Guards building in Whitehall. Another ceremony takes place at the Tower of London, which is guarded by colourfully outfitted *yeomen warders,* or *beefeaters.* Each night at 10 o'clock, the chief warder locks the tower gates and presents the keys to the tower's governor. This custom is nearly 700 years old.

Two of London's most spectacular ceremonies are *Trooping the Colour* and the *Lord Mayor's Show.* Trooping the Colour forms part of the queen's official birthday celebration each June. Riding in a horse-drawn carriage, the queen leads the Guards Division and Household Cavalry past cheering crowds along the Mall to Horse Guards Parade. There, the queen inspects the troops, and the *colour* (ceremonial flag) is carried in review.

The Lord Mayor's Show takes place in the City on the second Saturday in November to celebrate the election of a new lord mayor. The new mayor, dressed in traditional robes and riding in a horse-drawn coach, leads a parade through the streets of the City.

Economy

London is Britain's chief economic centre. Its businesses employ a fifth of Britain's workers.

Manufacturing. The leading industries include printing and publishing, and the manufacture of clothing, food products, furniture and precision instruments. The oldest industrial areas lie just north and east of the City. Another industrial area extends eastwards from Greenwich along the Thames. The newest industrial areas are situated in the western boroughs.

Trade. London has long been a great world port and trading centre. The Port of London Authority controls two huge docks and 69 kilometres of wharves along the Thames. In the past, the chief docks and wharves were just east of London Bridge and Tower Bridge. These facilities still handle some shipping. But the growth of *container shipping* during the 1960's required new facilities to handle *container ships.* These ships are designed to carry cargo packed in huge boxlike containers. The new container facilities were built at Tilbury, near the mouth of the Thames.

Finance and business. Banking, insurance, and finance are important industries in the City. Great financial institutions in the City include the Bank of England; the London Stock Exchange; and Lloyd's, the famous worldwide insurance company.

Transportation. Motorways and major roads, and underground and surface railways carry more than 1 million commuters between the outlying areas and central London each workday. Some travel by bus and others use their cars. The London underground railway system, which Londoners call the *tube,* is one of the largest in the world.

Heathrow Airport in western London is one of the world's busiest airports. It handles about 35 million passengers yearly. Gatwick Airport, another airport used by Londoners, lies about 45 kilometres south of Greater London. It handles about 19 million passengers yearly. Stansted Airport, in Essex, about 48 kilometres north of London, was upgraded in 1991 with a new terminal.

Communications. London is Britain's chief communications centre. The country's 12 national morning newspapers and 11 national Sunday papers are based in London. The British Broadcasting Corporation (BBC), the public national radio and television service, has its main offices and studios in London. Many independent broadcasting organizations are also based there.

Tourism. Millions of tourists from other parts of Britain and from overseas visit London each year.

Government

From 1965 to 1986, the government of the Greater London area consisted of the governments of the 32 boroughs, the City government, and the Greater London Council. The Greater London Council was a governing body that had authority over the governments of the boroughs and the City. It also had charge of such activities as overall city planning, road construction, traffic flow management, and fire-fighting services.

The Greater London Council was abolished by an act of Parliament that went into effect in 1986. Today, the Greater London area is governed chiefly by the governments of the 32 boroughs and the City of London.

Borough governments. Each London borough has its own government, in the form of an elected council. Borough residents elect new councils every four years.

The borough councils are responsible for local health and welfare services, public libraries, and some public housing. Each borough also maintains state-run schools in its area. The boroughs of London receive most of their income from a community charge (poll tax), rents, and grants from the national government.

The government of the City of London is organized much as it was hundreds of years ago, when many thousands of people lived inside the City's walls. Today, the City has only about 4,400 residents, far fewer than even the smallest borough. But the City has such an important place in British history that it has equal standing with the boroughs.

An organization called the Corporation of the City of London governs the City. It acts through the Court of Common Council. The Court of Common Council consists of the lord mayor, 24 aldermen, and 136 common councilmen. The lord mayor is the City's chief administrator. Voters elect the aldermen to life terms and the councilmen to one-year terms. Each year, the aldermen and guild representatives elect the lord mayor.

Other public agencies. The London Regional Transport Authority provides several public transportation services. Its members are appointed by the British government. The national government also appoints the members of the Port of London Authority, which controls shipping activities.

Another government agency is the Metropolitan Police Force. It provides police protection for all of Greater London except the City, and has its headquarters at New Scotland Yard. The City has its own police force.

During World War II, German bombs destroyed much of London. Prime Minister Winston Churchill, *front,* inspects the ruins after a raid. The worst raids came in late 1940 and early 1941.

History

London began about A.D. 43, when armies of the Roman Empire started to conquer Britain. The Romans built a seaport on the Thames near present-day London Bridge. They probably chose this site because the riverbanks east of this point were too marshy for settlement. The Romans called the port *Londinium.* The name *London* comes from this word.

By the early 200's, the Romans had built a wall around London, possibly to protect it from raiders. This wall, and the ones that later replaced it, formed London's boundaries for hundreds of years.

In 410, barbarian invaders attacked Rome. The Roman troops in Britain were called home to fight the invaders. This date thus marks the end of Roman control over Britain. Little of Roman London remains, except for parts of the original wall and the ruins of a few buildings.

The Middle Ages. London grew little from the 400's to the 1000's. But in the mid-1000's, the Saxon king Edward the Confessor built a palace and rebuilt a church about 3 kilometres southwest of London. Before then, Saxon kings had lived mainly at Winchester, in south-central England. Edward's buildings became the start of the City of Westminster. The Palace of Westminster served as a chief residence of England's rulers until the 1520's. The church became Westminster Abbey. In 1066, William the Conqueror was crowned king in Westminster Abbey. William granted Londoners self-government. During William's reign, many cathedrals and castles were built. He also began construction of the Tower of London.

Other London landmarks also appeared during the Middle Ages. About 1100, work began on Old St. Paul's Cathedral to replace a church destroyed by fire. Builders finished it about 200 years later. In 1209, London Bridge became the first stone bridge across the Thames.

London's craft and trade guilds began to develop in the 1100's. Each guild represented certain craftworkers or tradespeople, such as bakers, carpenters, goldsmiths, and grocers. The guilds were also called *livery companies* because each had its own *livery*—that is, official robes that the guild members wore on special occasions.

Guild members elected London's first mayor in the 1190's. In 1215, King John confirmed London's right to govern itself. By the late 1400's, London had about 50,000 people. Its mayor had become so important that he was now called the *lord mayor.*

Expansion beyond the walls. London grew rapidly during the 1500's and the first half of the 1600's. Nobles built estates to the west, just outside London's walls. King Henry VIII owned at least six palaces in the London area, including the Palace of Westminster. In 1547, the year Henry died, the Palace of Westminster became the meeting place of Parliament.

London developed into an important world trading centre under Queen Elizabeth I, who reigned from 1558 to 1603. England's first public theatres opened in London's suburbs during Queen Elizabeth's reign. One of the most popular theatres was the Globe, in Southwark. William Shakespeare began to present his plays at the Globe about 1599. See **Shakespeare, William.**

By the mid-1600's, London had about half a million people. Most Londoners now lived outside the walls in such districts as Clerkenwell, St. Giles, and Whitechapel, which were rapidly becoming slums. The area inside the walls gradually came to be known as *the City.*

War, plague, and fire struck London in the mid-1600's. A struggle for power between King Charles I and Parliament resulted in civil war in 1642. London sided with Parliament, led by Oliver Cromwell and other Puritans. London grew less prosperous under the Puritans, who made themselves unpopular by closing the theatres.

The Great Plague—a terrible epidemic of *bubonic plague*—broke out in London in 1665. Before the epidemic died down in 1666, it had taken about 100,000 lives. On Sept. 2, 1666, the Great Fire of London broke out in a baker's shop on Pudding Lane in the City. It was finally brought under control five days later. Most of the City, built largely of wood, lay in ashes. The losses included St. Paul's Cathedral and about 13,000 houses. But the fire caused no known deaths.

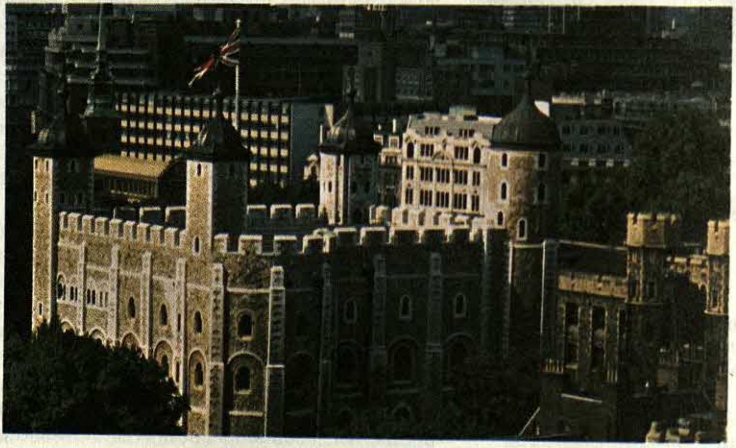
Rebuilding the City. Londoners rebuilt the City with brick and stone instead of timber. The great architect of the new City was Sir Christopher Wren, who rebuilt many structures lost in the fire, including St. Paul's Cathedral. But few people returned to live in the City.

London's businesses soon recovered from losses suffered in the Great Fire. A new Royal Exchange opened about 1675. But the favourite places for doing business were the many coffee houses that sprang up in and near the City. Lloyd's insurance company started in the coffee house of Edward Lloyd in the 1680's. The London Stock Exchange began in the 1700's in a coffee house called Jonathan's.

The world's largest city. By 1800, London had about a million people, more than any other city in the world. During the Industrial Revolution in the 1800's, London developed markets for factory-produced goods. The City's merchants and bankers made enormous fortunes. But many workers were desperately poor. They lived in crowded, disease-ridden slums.

The growth of the suburbs. During the 1800's, more and more Londoners moved to the outlying areas. This rapid suburban growth became possible largely because of improved transportation.

The first major reform of London's government took place in 1888. The County of London was formed that year, and the London County Council was organized as its chief governing body. The county covered an area about a fifth the size of present-day Greater London.



The Tower of London has served as a fortress, a palace, and a prison. Today this national monument is a popular tourist attraction. Visitors can see the Crown Jewels and a museum containing a collection of armour.

Destruction from the air. In the summer of 1940, Germany began an all-out air attack on Britain. London became the chief target of the attack. The Blitz, as the attack was known, lasted from September 1940 to May 1941. Night after night, German planes dropped bombs on the built-up area.

Postwar developments. City planners had drawn up a new plan for London during the war. It called for a wide band of open country, a Green Belt, around London and for new towns to be built outside the belt. The plan also called for the rebuilding of heavily bombed areas and the development of the South Bank. In the 1960's, skyscrapers began to appear in central London, changing the skyline dramatically.

As London built upward, it also continued to spread outward. The London Government Act, passed by Parliament in 1963, replaced the County of London with Greater London. It also divided Greater London into 32 boroughs and created the Greater London Council (GLC). By the 1980's, many people believed that the GLC was too large and unwieldy a body to govern London efficiently. For this and other reasons, the GLC was abolished in 1986 by Act of Parliament, and responsibility for London's local government passed to the 32 boroughs.

London was long noted for its smogs, caused mainly by smoke from houses and industries. A terrible smog in 1952 killed about 4,000 Londoners. Parliament passed a Clean Air Act in 1956, which limited the use of smoke-producing fuels in London. By the 1970's, London was noted for its clean air.

Motor traffic remains one of London's worst problems. The government has proposed building more motorways in central London. But many people oppose the plan because it requires moving hundreds of families from their homes. To relieve some of the traffic problems, the government built a motorway, called the M25, which completely circles London. It opened in 1986.

In 1981, the government set up the London Docklands Development Corporation to develop derelict land around the docks area of east London. The corporation's task was to attract new businesses and residents to the area. In 1987, the Docklands Light Railway opened to help supply public transport to the region.

Study aids

Related articles in *World Book* include:

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Lloyd's
London, University of
London Bridge
Newgate Prison
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Saint James's Palace
Scotland Yard
Thames, River
Tower of London
Trafalgar
United Kingdom
Westminster Abbey
Westminster School
World War II (The Battle of Britain)
Wren, Sir Christopher

Outline

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London, Ontario, Canada (pop. 269,140; met. area pop. 342,302), is a distributing, financial, manufacturing, medical, and transportation centre in the southern part of the province. London lies on the Thames River, midway between Toronto and Detroit. British settlers named the town after London, England.

The city's chief products include beverages, chemical and electrical products, diesel vehicles, foods, hosiery, and telephone equipment. Printing is also an important industry.

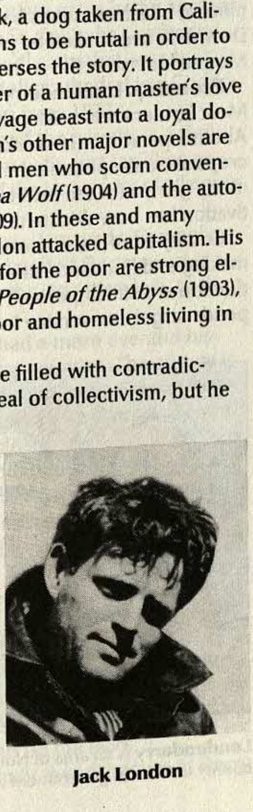
London, Fires of. See **Fires of London.**

London, Jack (1876-1916), was an American author, journalist, and political activist. He became the most widely read American author. Much of London's fiction can be read as juvenile adventure stories. But beneath the surface of his best work, he dealt with complex adult themes.

John Griffith London was born in San Francisco. His childhood was marked by emotional and economic deprivation. Between the ages of 16 and 19, he held many jobs connected with the sea. In 1897, London travelled to Canada to seek his fortune in the gold rush in the Yukon Territory. The trip to the Klondike region of the Yukon was a major turning point in London's life. He found materials there that would allow him to express his major literary theme, the struggle for survival of strong men driven by primitive emotions. London's first Klondike stories, collected in *The Son of the Wolf* (1900), made him a best-selling author.

London was fascinated with *environmental determinism,* which states that the world shapes us in ways we are powerless to resist. This is the theme of London's two great animal novels. *The Call of the Wild* (1903) describes the adventures of Buck, a dog taken from California to the Yukon. Buck learns to be brutal in order to survive. *White Fang* (1906) reverses the story. It portrays a wolf who, through the power of a human master's love and kindness, turns from a savage beast into a loyal domestic animal. Among London's other major novels are two that portray strong, brutal men who scorn conventional social attitudes—*The Sea Wolf* (1904) and the autobiographical *Martin Eden* (1909). In these and many other novels and essays, London attacked capitalism. His understanding and sympathy for the poor are strong elements in such works as *The People of the Abyss* (1903), a journalistic report on the poor and homeless living in London, England.

London's life and work were filled with contradictions. He upheld a socialist ideal of collectivism, but he also held a cruelly individualistic notion of the survival of the fittest. He praised democracy, but he saw his own success as illustrating the rightness of the concept of the superman who stands above ordinary humanity and prevails by force of will. This philosophy had been developed by the German philosopher Friedrich Nietzsche. London advocated brotherhood, but he believed that people of the "Anglo-Saxon" or "Teutonic" races were superior to "coloured" people.



Jack London

London, Tower of. See **Tower of London.**

London, Treaties of. Throughout history, many international treaties have been signed in London. Some of them are described in this article.

The Treaty of 1913 was an attempt to end the first Balkan War. Delegates from Greece, Serbia, Bulgaria, and their enemy, the Turkish Ottoman Empire, signed it on May 30, 1913. The defeated Turks were allowed to keep a small European foothold in eastern Thrace. Greece received Salonika, southern Macedonia, and Crete. Serbia gained central and northern Macedonia, and Bulgaria took western Thrace and the northern coast of the Aegean Sea. The treaty caused new conflicts. On June 29, 1913, Bulgaria attacked Greece and Serbia, and the second Balkan War began. See **Balkans.**

The Treaty of 1915 was a secret treaty signed by Great Britain, France, Russia, and Italy. In return for entering World War I against Germany, Italy was promised the southern Tyrol, northern Dalmatia, Istria, and Gorizia. See **World War I** (The Italian Front).

The Treaty of 1930 became known as the London Naval Treaty. On April 22, 1930, the United States, France, the British Empire, Italy, and Japan signed the pact to limit and reduce naval armaments. The treaty tried to place limitations on cruisers, destroyers, and submarines. It allowed the United States, Great Britain, and Japan to increase warship production if another power increased its naval production. France and Italy did not sign part of the treaty.

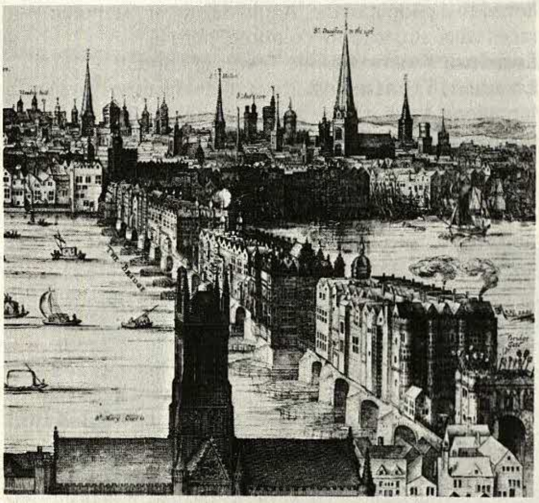
The Treaty of 1936 reaffirmed the naval treaty of 1930. The United States, France, and Great Britain signed it on March 25, 1936.

London, University of, is the largest traditional university in Great Britain. Only the British Open University, which has no classrooms and involves instruction through radio, television, and written correspondence, has more students. The University of London is made up of several institutions located in or near London. It consists of 29 schools, each controlled by its own governing body, and 12 institutes established by the university government. These schools and institutes include the Courtauld Institute of Art, the London School of Economics and Political Science, St. Bartholomew's Hospital Medical College, the School of Oriental and African Studies, and University College. The university was founded in 1836. In 1878, it became the first university in Great Britain to grant degrees to women.

London Bridge is one of 15 bridges in London that span the River Thames. Construction of the bridge began in 1967 and was completed in 1973. For location, see **London** (map).

The bridge replaced the famous London Bridge that was built between 1823 and 1831. Workers began dismantling the older bridge in 1967 because it was settling into the river and cracks were developing. The bridge was reconstructed in Lake Havasu City, Arizona, U.S.A.

The London Bridge of the 1800's replaced a stone bridge that was completed in 1209, about 30 metres downstream. The stone bridge stood on the site of an earlier wooden bridge. Houses lined both sides of the stone bridge, and the heads of executed traitors sometimes hung over the entrance. It was the only bridge



Old London Bridge, shown in this engraving by Visscher, was the only bridge across the River Thames between 1209 and 1750.

over the Thames until 1750. Repairs kept the bridge in use until it was torn down about 1832.

London Company was an association of "noblemen, gentlemen, and merchants" during the early days of the American colonies. It was part of a larger association, the Virginia Company. In 1606, King James I of England chartered the London Company to form a colony in North America. It founded the Jamestown colony in 1607.

The founders of the London Company believed that precious metals existed in the Americas. Those who went to America and risked their lives were called *planters.* Those who stayed in England and invested their money in the company were called *adventurers.* Each planter and adventurer was to share in the company's profits. But the company failed to profit. The company reorganized under new charters in 1609, and again in 1612. But still there were no profits.

The House of Burgesses was formed in Jamestown in 1619. It was the first representative legislative body in the American colonies. The House passed measures designed to help the company prosper. But a serious Indian uprising in Jamestown in 1622 caused the adventurers to lose what little interest they had left.

In 1623, King James decided that the company was being managed poorly. He took over the association in 1624 and dissolved the company.

London Gazette publishes routine notices from central and local government in Britain, and British legal notices. It is published four times a week—on Monday, Tuesday, Thursday, and Friday—by Her Majesty's Stationery Office. The *London Gazette* was formerly known as the *Oxford Gazette.* It was founded in 1665 at Oxford, where Charles II and his court had taken refuge from the Great Plague. Its name was changed to the *London Gazette* after the court returned to London late in 1665.

Londonderry is one of the six counties of Northern Ireland. The county ceased to be an administrative area when local government was reorganized in 1973. But local people continue to regard the county as important for historical reasons. Londonderry is known throughout the world because of the song "The Londonderry Air," which is also popularly known as "Danny Boy."

The name of the city and county has long been a source of disagreement between the two religious communities in Northern Ireland. The original name Derry comes from the Irish word *doire,* which means an oak wood. In 1984, the nationalist-controlled council renamed the district which includes the city Derry. Ulster loyalists insist that its name should be Londonderry. The county has always had the official name Londonderry. In ordinary speech, however, both communities use the name Derry.

According to the 1971 census, the county had a population of 183,094. The government no longer collects figures for the population living within the old boundaries.

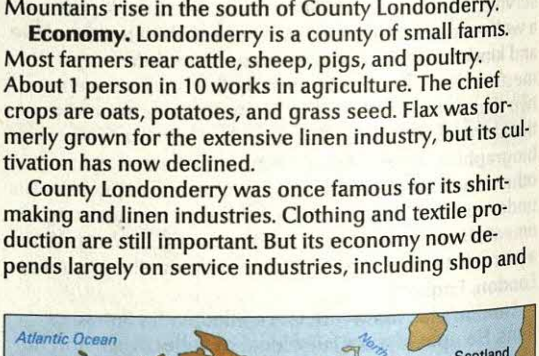
The administrative district, now known as Derry, was formed in 1973. It takes in most of the old city of Londonderry, which was a county borough until the 1973 reorganization. The rest of the old county was divided among the administrative districts of Limavady and Magherafelt. Parts of the county were absorbed into the Cookstown and Coleraine districts.

The old county of Londonderry covers 21,182 square kilometres. Most of it lies between the River Foyle and the River Bann. But most of Derry district is on the west bank of the Foyle. The town of Coleraine is on the east bank of the Bann. The county forms a rough triangle. The Bann is its eastern side, the Atlantic Ocean and Lough Foyle are on the north, and the Sperrin Mountains are on the southwest.

The mouth of the wide Lough Foyle is almost closed by a long spit of land ending in Magilligan Point. A magnificent beach stretches back from there to the village of Downhill, overlooked by picturesque cliffs. The Sperrin Mountains rise in the south of County Londonderry.

Economy. Londonderry is a county of small farms. Most farmers rear cattle, sheep, pigs, and poultry. About 1 person in 10 works in agriculture. The chief crops are oats, potatoes, and grass seed. Flax was formerly grown for the extensive linen industry, but its cultivation has now declined.

County Londonderry was once famous for its shirtmaking and linen industries. Clothing and textile production are still important. But its economy now depends largely on service industries, including shop and



Londonderry is an area of Northern Ireland administered as a county until local government was reorganized in 1973.

The Guildhall on the banks of the Foyle is part of the historic centre of the city of Londonderry. The old walled part of Derry dates back to the 1600's. Modern suburbs have been built on the other side of the river.

office work, and catering. Light engineering and chemical production are also important.

Chief towns. Londonderry is Northern Ireland's second city. It is linked to the capital, Belfast, by rail and an excellent road system, including part of the M2 motorway and dual carriageway roads. Londonderry is also an important manufacturing centre and port. Its heart is the old walled city of Derry beside the river. But it now has extensive suburbs on both banks of the Foyle. The central square, called the Diamond, is at the intersection of the streets leading to the four main gates in the ancient walls, which are still standing. St. Columba's cathedral, the Protestant (Church of Ireland) cathedral, was built in 1633. St. Eugene's Roman Catholic cathedral is a Gothic-style, Victorian building, dating from 1873.

Coleraine, on the other side of the county, is a thriving business and market centre with port facilities on the Bann. The main campus of the University of Ulster is situated just outside the town.

Other market towns are Kilrea, Limavady, Garvagh, Dungiven, Maghera, and Magherafelt. Portstewart is a picturesque seaside resort on the Atlantic coast, to the northwest of Coleraine.

History. Londonderry has had a more eventful history than any of the other Ulster counties. The county is rich in evidence of prehistoric settlement. Special features include large, ancient, burial chambers and circular, stone *raths,* which are enclosures used as dwellings or forts. In 546, St. Columba founded a monastery at Derry, from which he set out to establish the Christian community on Iona. The area suffered little from the Viking and Norman invasions of Ireland. But in 1609 the land around the mouth of the Bann, then called Coleraine, was granted by King James I to the corporation of London. A society called *The Honourable the Irish society* was responsible for organizing the grant. Parts of the county were assigned to 12 of the leading livery companies of London, each of which was to found a town. The settlement was only partly successful, and many of the original, Irish tenants remained on the land.

The London companies rebuilt the Irish town of Derry as a walled city, and renamed it Londonderry. In 1688, when the Catholic King James II fled to Ireland, leaving his English throne to William III, Londonderry became a city of refuge for thousands of Protestants. In December 1688, while the city fathers hesitated, 13 boy apprentices shut the gates in the face of James's troops. A siege began soon after. It lasted until July 1689, when a Derry ship broke the boom across the Foyle and the city was relieved. Many relics of the siege can still be seen in St. Columba's cathedral.

The annual celebration of the siege by Protestants has been resented by the Catholic population over the years, and political control of the city has been a matter of bitter dispute. The city was the setting for fierce riots in 1968. The riots developed into a long period of violence, which led to the posting of United Kingdom troops to Northern Ireland in 1969 and the abolition of Northern Ireland's parliament and government in 1972. During this long period of conflict, areas such as the Roman Catholic housing estate of the Bogside have appeared in many news reports. The city has undergone considerable modernization, with the building of new houses, sports complexes, and an art gallery.

See also **Ireland, History of; Northern Ireland.**

Long, Crawford Williamson (1815-1878), was an American who, in 1842, became the first doctor to use ether as an anaesthetic for surgery. The anaesthetic properties of ether had been demonstrated at "ether frolics", during which people took small amounts of ether to experience its strange effects. Long also had experimented with its effects on himself. On March 30, 1842, Long gave ether to James Venable and painlessly removed a tumour from Venable's neck. Long did not announce his experiment at the time and it received no professional or general publicity. Long himself remained unaware of the full value of anaesthesia in surgery, although he continued to make occasional use of ether. Finally, in 1849, he published a description of his experiments with ether.

Long was born in Danielsville, Georgia, U.S.A. He graduated from the Medical School of the University of

Pennsylvania in 1839. The Crawford W. Long Medical Museum in Jefferson, Georgia, exhibits some of his papers and early anaesthesia equipment. A statue of Long represents Georgia in the U.S. Capitol.

See also **Anaesthesia; Ether; Morton, William T. G.**

Long Beach, California, U.S.A. (pop. 429,433), is a major industrial centre, seaport, and tourist area in the southern part of the state. Long Beach is also the site of Long Beach Naval Station and Long Beach Naval Shipyard.

Leading industries in Long Beach include aircraft and electronics manufacturing, food processing, and oil production. The city is the site of the Wilmington Oil Field, which has produced several billion barrels of oil since its discovery in 1936.

Long division. See **Division.**

Long house. See **Indonesia** (Shelter; picture); **Indian, American** (Shelter; picture).

Long Island (pop. 6,861,474) is an island that forms the southeastern part of New York. Its population is greater than that of 41 of the 50 states of the United States. The island consists of crowded urban areas, large suburban areas, and smaller residential towns. Farms, fishing villages, and resort centres lie towards the eastern part. A section of western Long Island forms part of New York City.

Location and size. Long Island extends eastward from the Narrows in New York Bay for about 190 kilometres. It covers 4,406 square kilometres and is the largest island in area off the mainland United States. The island divides at its eastern end into two narrow peninsulas. One peninsula, the North Fork, is about 40 kilometres long. The other peninsula, the South Fork, is 65 kilometres long. Along most of its southern shore, the island is protected from the ocean by many barrier beaches, which include Fire Island National Seashore, Jones Beach, Long Beach, and Westhampton Beach.

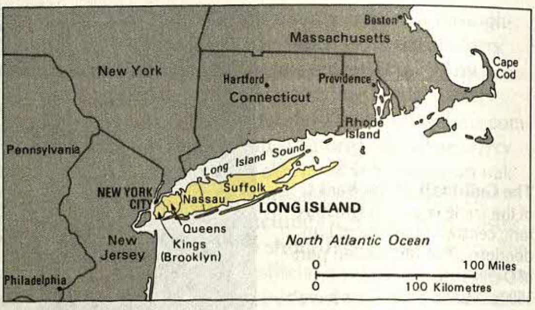
The counties. Long Island consists of Kings, Queens, Nassau, and Suffolk counties. Kings County (Brooklyn) and Queens County form a major part of New York City.

The leading industry in Long Island manufactures aircraft. Other major industries include electronics and plastics. In Suffolk County, deep-sea fishing, oyster cultivation, and tourism are important economic activities. Farming also generates income. Farms are located in the northeastern part of the county. The Brookhaven National Laboratory in the county is a centre for scientific research.

History. The explorer Henry Hudson reached Long Island in 1609. Later during the 1600's, the Dutch settled in the western end of the island, and New Englanders settled in the eastern part. One of the most important battles of the American Revolution, the Battle of Long Island, took place in present-day Brooklyn on Aug. 27, 1776. The British defeated the Americans, but the colonial troops escaped.

The island became a residential area in the early 1840's, after a railway was built along its northern shore. By the early 1900's, fabulous mansions had been constructed in Nassau. Long Island experienced rapid growth after major roads were built in the mid-1900's. Between 1940 and 1960, Nassau County's population tripled, while that of Suffolk County quadrupled.

See also **New York City.**



Location of Long Island

Long jump. See **Athletics.**

Long Parliament refers to a session of the English Parliament that lasted without a break from 1640 to 1653. It was not formally dissolved until 1660. The Long Parliament opened with a direct conflict with King Charles I, met during the Civil War, ordered the king's execution, tried to rule in the uneasy years after the war, and was finally dissolved to make way for a new Parliament under King Charles II.

In its early sessions, the Long Parliament made many lasting political reforms. It abolished the hated court of the Star Chamber, where people were tortured for confessions and tried without a jury. It declared that the king could not collect money without its consent, or dissolve Parliament without its consent. It also brought about the execution of Charles's chief advisers, the Earl of Strafford and Archbishop William Laud.

On religious questions, the Long Parliament was seriously divided. Presbyterians opposed Puritans, and neither side would budge. Civil war began when the king's supporters withdrew from Parliament, and the House soon became divided into Presbyterians, who were moderate royalists, and Independents, who were republican in sympathy. The army, under Oliver Cromwell, supported the Independents. In 1648, a detachment under Colonel Thomas Pride kept the Presbyterian majority from entering the House. "Pride's Purge" resulted in what was called "the Rump Parliament," which had less than a fourth of the usual number of members. This remainder of the Long Parliament carried out the execution of Charles I and made England a commonwealth.

Cromwell, the real power in the commonwealth, found that the Rump Parliament was determined to hold onto its power. He suppressed it in 1653, leaving England without any representative legislature. But the people tired of Puritan dictatorship. The Long Parliament met again in 1660 and called elections. Charles II took the throne soon afterward.

Related articles in *World Book* include:

Charles (I) of England
Cromwell, Oliver
England (The Civil War)
Rump Parliament
Star Chamber

Longbow. See **Archery** (History).

Longevity, or *Length of life.* See **Life expectancy.**

Longfellow, Henry Wadsworth (1807-1882), was the most widely published and most famous American poet of the 1800's. His reputation among critics declined sharply after his death, and he had much less influence on modern poetry than such other poets of his day as

Longfellow in 1869, *left,* posed for this photograph with members of his family in Florence, Italy. His second wife, Frances Appleton, *above,* died in a fire in 1861. This great tragedy in Longfellow's life inspired perhaps his finest poem, "The Cross of Snow."

Walt Whitman and Emily Dickinson. However, many of his poems remain among the most familiar in American literature.

Longfellow's best-known longer works include *Evangeline, The Song of Hiawatha,* and *The Courtship of Miles Standish.* Among his popular shorter poems are "The Village Blacksmith," "The Children's Hour," "Paul Revere's Ride," "The Wreck of the Hesperus," and "Excelsior." Longfellow's verse was translated into many languages, and he became known throughout most of the Western world. He was the first American writer to be honoured in the Poets' Corner of Westminster Abbey in London.

Longfellow was born on Feb. 27, 1807 in the American seaport of Portland, Maine (then in Massachusetts). His mother was the daughter of Peleg Wadsworth, a general in the American Revolution. Henry's father was a lawyer. A love of the sea influenced his writing throughout his life. He became professor of modern languages at Bowdoin College in Brunswick, Maine, and was then offered a similar post at Harvard College. To prepare himself, he travelled widely in Europe. His first wife died in the Netherlands in 1835, following a miscarriage. Longfellow took up his teaching duties at Harvard in 1837. His first book, a collection of travel sketches, had appeared two years earlier. Longfellow remarried in 1843, and had six children.

Longfellow lived at Craigie House, near Harvard, which is now a museum. By the late 1840's he was a celebrity, the most popular narrative poet of his time. He left Harvard in 1854 to concentrate on writing, and the next seven years were his most productive. In 1861, his wife Frances was killed when her dress caught fire. Longfellow died in Cambridge, Massachusetts, on March 24, 1882.

Longfellow translated poetry from 18 languages. His most significant translation, published in 1867, was of Dante Alighieri's medieval poem the *Divine Comedy.* Longfellow worked on the translation over a period of several years. A group of writers known as the Dante Club met at Craigie House once a week to offer critical advice on the translation. The group included the poet James Russell Lowell (see **Lowell, James Russell**).

In the finished work, a pair of Longfellow's original sonnets precedes each of the three major sections of the *Divine Comedy.* The sonnets are among Longfellow's best lyric poems. Some scholars feel that Longfellow made the finest translation of the *Divine Comedy* in the English language.

To the modern reader, Longfellow's sentimental and optimistic poetry often makes him seem somewhat old-fashioned. In fact, however, he consistently experimented in verse forms from outside the English poetic tradition. He used his extensive knowledge of the literature of other countries as a source for both the form and content of much of his poetry. This added energy to his work and made it more interesting at a time when most poetry had become rather predictable.

Longford is the title name of a British family that is associated with politics and the arts.

Earl of Longford, Francis Aungier Pakenham (1905-), held a number of high offices in the Labour government from 1964 to 1968. He was leader of the House of Lords for four years. He was also lord privy seal in 1964 and 1965, secretary of state for the colonies in 1965 and 1966, and lord privy seal again from 1966. He resigned from the government in 1968.

Lord Longford was born in London and educated at Eton and at Oxford University. In the Labour government of 1945 to 1951, he held several posts, including those of minister of civil aviation and first lord of the Admiralty. He wrote two books on prison reform and an autobiography, *Born to Believe* (1953). During the late 1960's and early 1970's, he became well known for his campaign against pornography in the United Kingdom.

Countess of Longford, Elizabeth Pakenham (1906-), was also active in Labour politics. Under the name of Elizabeth Longford, she published several books on history, biography, and social topics. Her outstanding biography of Queen Victoria was published in 1964. She published *The Royal House of Windsor* in 1974.

Lady Antonia Fraser (1932-), daughter of the Earl and Countess of Longford, became a writer and broadcaster. She published several books on the monarchy, including *Mary Queen of Scots* (1969), *Kings and Queens of England* (1975), and *King Charles II* (1979).

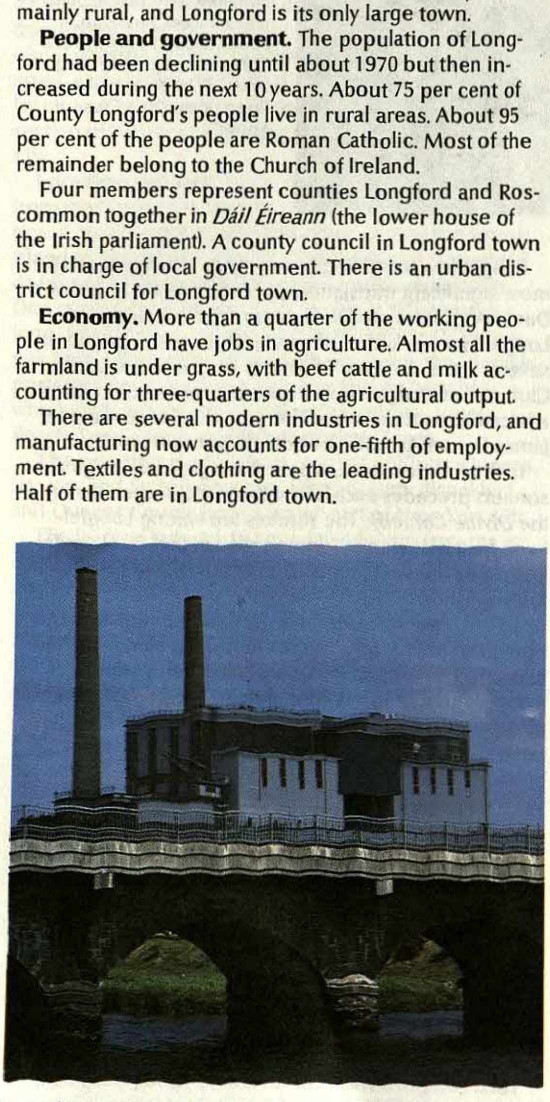
Longford is a county in the province of Leinster in the Republic of Ireland. It is a small county in the northern part of the central lowland of Ireland. The county is mainly rural, and Longford is its only large town.

People and government. The population of Longford had been declining until about 1970 but then increased during the next 10 years. About 75 per cent of County Longford's people live in rural areas. About 95 per cent of the people are Roman Catholic. Most of the remainder belong to the Church of Ireland.

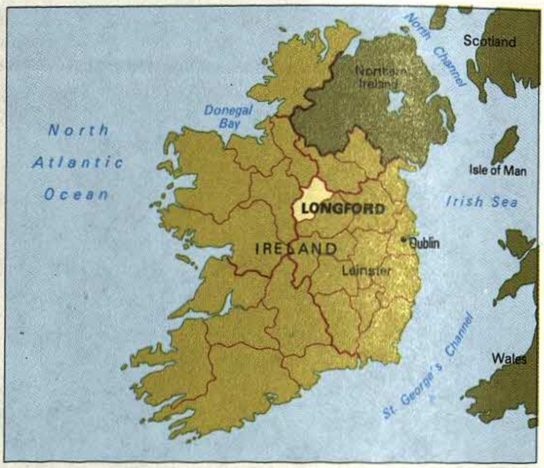
Four members represent counties Longford and Roscommon together in *Dáil Éireann* (the lower house of the Irish parliament). A county council in Longford town is in charge of local government. There is an urban district council for Longford town.

Economy. More than a quarter of the working people in Longford have jobs in agriculture. Almost all the farmland is under grass, with beef cattle and milk accounting for three-quarters of the agricultural output.

There are several modern industries in Longford, and manufacturing now accounts for one-fifth of employment. Textiles and clothing are the leading industries. Half of them are in Longford town.



Lanesborough power station, in Longford, produces electricity by burning peat. The peat is delivered by train.



Longford is a small, inland, rural county in the Republic of Ireland and is part of the province of Leinster.

About two-fifths of people in Longford work in varied service industries. These industries include education, health, public administration, retail and wholesale distribution, and transport. Longford town is the main centre for shopping and other services.

There is a peat-fired power station at Lanesborough on the River Shannon which uses peat from the county's bogs. Some areas of bog and wet soils have been planted with pine trees for timber production.

The most important road is the N4 from Dublin, to Longford town. Three roads go west from the town, across the River Shannon to Sligo, Mayo, and Roscommon. The N55 passes northward from Athlone to Cavan. The Dublin to Sligo railway runs northwest across Longford.

Land. Longford lies in the northwest of the province of Leinster, just southwest of the Ulster county of Cavan. Westmeath borders Longford to the east and south. The Connacht counties of Roscommon (to the west) and Leitrim (to the northwest) also border Longford. The maximum dimensions are 45 kilometres from north to south, and 35 kilometres from east to west.

Most of Longford is lowland, which rises gently from the River Shannon, with isolated hills. The underlying rock is limestone, with some slate and shale in the north. Most of the land is farmed, and about a fifth is bogland. Along the western boundary are the River Shannon and *Lough* (lake) Ree, into which flows the River Inny. Lough Gowna is in the north.

Longford has nearly 100 centimetres of rain a year. The average temperature in January is 4° C. In July the average temperature is 15° C.

Facts in brief about Longford

Population: *1991 census*—30,293.
Area: 1,044 km².
Largest towns: Longford, Granard, Ballymahon.
Chief products: *Agriculture*—cattle, milk, pigs. *Other primary products*—peat, timber. *Manufacturing*—clothing, food products, engineering goods, textiles, timber products.
Origin of name: From the Gaelic *Longfort* (the fortress).

History. Longford was once the territory of the O'Farrells of Annaly (Annaly was an earlier name of the area). This territory was the western extremity of the kingdom of Meath. In the 1100's, Longford was granted by the English king to Hugh de Lacy, an Anglo-Norman nobleman, but there was little Anglo-Norman impact in the area. The O'Farrells remained powerful and much of the county stayed under Irish control. In the 1600's, the British government gave lands to British settlers. The town of Longford developed from around that time. County Longford suffered greater population loss than any other Leinster county from the Great Famine in the 1840's. More than one-fourth of the people died or emigrated.

The poet Oliver Goldsmith was born at Pallas, near Ballymahon.

See also **Ireland, History of; Leinster.**

Longhorn. See **Cattle** (Beginning of breeding; picture).

Longinus is the name given to the unknown author of *On the Sublime,* an ancient Greek *treatise* (long essay) on literary criticism. Many scholars rank it second in importance only to Aristotle's *Poetics* among ancient writings on literature. *On the Sublime* was probably written during the first 100 years after the birth of Jesus Christ.

The treatise identifies five sources of sublimity in literature. The author used *sublimity* as another term for *greatness.* The sources of sublimity are (1) the ability to conceive great thoughts, (2) intense emotion, (3) powerful figures of speech, (4) the choice of noble words, and (5) harmonious composition of sentences. *On the Sublime* compares the literary styles of the Greek orator Demosthenes and the Roman orator Cicero. It discusses the effect of tyranny on literature.

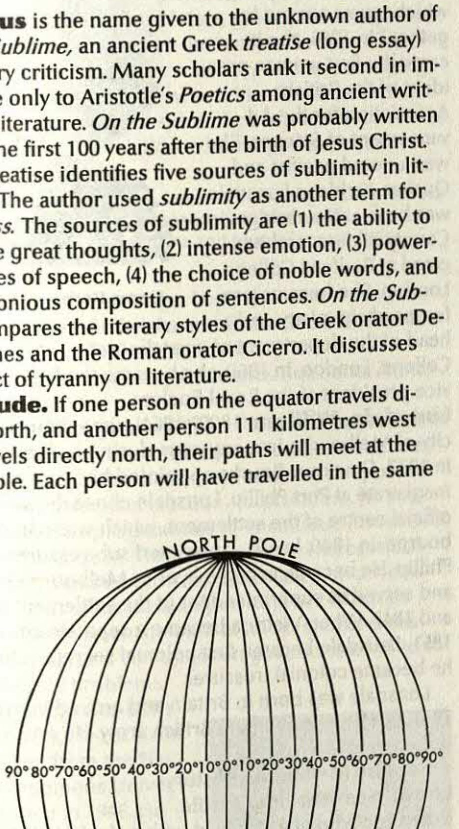
Longitude. If one person on the equator travels directly north, and another person 111 kilometres west also travels directly north, their paths will meet at the North Pole. Each person will have travelled in the same direction along a different *line of longitude.* Lines of longitude run north and south along the earth's surface. Mapmakers think of the earth as a huge globe divided into 360 equal slices. The lines between the slices on the outside of the globe are called *meridians.* Meridians are the main lines of longitude on maps.

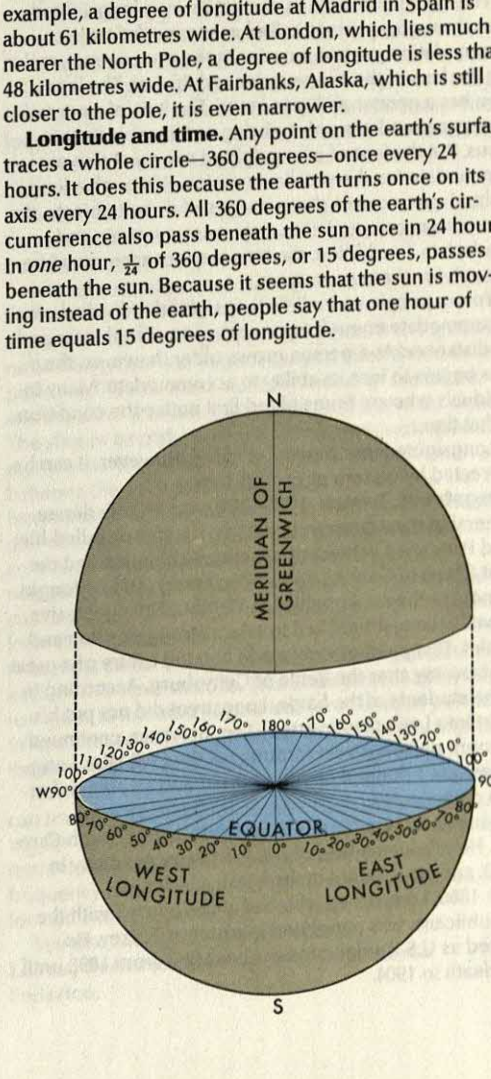
Longitude and location. Most countries start counting longitude east and west from an imaginary line running through Greenwich, a borough of London. These countries have agreed Greenwich lies at 0° longitude.

The earth is divided into two parts, or hemispheres, of east and west longitude. Each hemisphere has 180 degrees. Degrees of longitude are used to measure east and west distances on maps. They are used, along with degrees of *latitude,* to find certain points (see **Latitude**). For example, New York City lies at 74° west longitude. This means that if a person travels west from Greenwich to New York City and counts the imaginary meridians, New York City would lie on the 74th meridian west of Greenwich. Sailors and pilots use longitude to help determine the location of their ships and aeroplanes.

The space between two meridians is greatest at the equator—about 111 kilometres. This space narrows as the meridians approach the North and South poles. For example, a degree of longitude at Madrid in Spain is about 61 kilometres wide. At London, which lies much nearer the North Pole, a degree of longitude is less than 48 kilometres wide. At Fairbanks, Alaska, which is still closer to the pole, it is even narrower.

Longitude and time. Any point on the earth's surface traces a whole circle—360 degrees—once every 24 hours. It does this because the earth turns once on its axis every 24 hours. All 360 degrees of the earth's circumference also pass beneath the sun once in 24 hours. In *one* hour, $\frac{1}{24}$ of 360 degrees, or 15 degrees, passes beneath the sun. Because it seems that the sun is moving instead of the earth, people say that one hour of time equals 15 degrees of longitude.





Meridians of longitude are lines drawn from north to south on maps and globes to indicate distances and locate points. The prime meridian passes through Greenwich, England, *right.* All meridians of longitude meet at the North and South poles, *above.* The distance between meridians is greatest at the equator. It gradually decreases as the meridians near the poles.

Each degree of longitude is divided into 60 parts called minutes. Each minute is divided into 60 seconds of longitude. One minute is written as 1′, and one second as 1″. These minutes and seconds of longitude measure distance, not time. But since an hour of time equals 15° of longitude, a minute or second of time equals a certain distance that can be expressed in minutes and seconds of longitude.

The following table gives the equivalent in distance for five units of time. These units range from a day to a second:

24 hours of time = 360° of longitude.
1 hour of time = 15° of longitude.
4 minutes of time = 1° of longitude.
1 minute of time = 15′ of longitude.
1 second of time = 15″ of longitude.

See also **Map; Meridian; Time.**

Longsightedness, is a visual defect in which a person can see distant objects clearly, but near vision may be blurred. Doctors call this condition *hyperopia.* In most cases of longsightedness, the eyes are too short from front to back. As a result, light rays from an object reach the retina before they can be brought into focus.

The eye may be able to correct its own longsightedness through a process called *accommodation.* In accommodation, certain muscles in the eye contract, making the lens of the eye rounder and thicker. The lens then has a greater ability to focus. The lens of a normal eye accommodates only to bring nearby objects into focus. But the lens of a longsighted eye must also accommodate for sharp distance vision. Although a longsighted eye receives sharp images of distant objects, the excessive accommodation may cause eyestrain and headaches. In addition, the lens may not accommodate enough for sharp near vision.

Young people and mildly longsighted individuals can accommodate enough for sharp vision at both near and far distances. As a person grows older, however, the lens begins to lose its ability to accommodate. Many individuals who are longsighted first notice the condition at that time.

Longsightedness cannot be cured. However, it can be corrected by glasses or contact lenses.

Longstreet, James (1821-1904), was a Confederate general in the American Civil War. His troops called him "Old Pete." As a lieutenant general, he commanded the First Corps of General Robert Lee's army, and he fought in most of the major battles in Virginia. Not aggressive in battle, Longstreet liked to take a strong position and hold it. This point of view made him the centre of a great controversy after the Battle of Gettysburg. According to some students of the battle, Longstreet did not put his heart into Lee's plan of attack. Lee, however, continued to count on Longstreet throughout the Civil War. Longstreet was a dogged combat soldier and an able defencive commander.

Longstreet was born in Edgefield District, South Carolina. He graduated from the U.S. Military Academy in 1842, and later fought in the Mexican War.

In 1880, Longstreet, who had allied himself with the Republicans, was appointed minister to Turkey. He served as U.S. commissioner of railways from 1898 until his death in 1904.

Lonsdale, Lord (1857-1944), Hugh Cecil Lowther, a leading British sportsman of his time, founded the *Lonsdale Belts* for boxing. They are given to the British titleholder in each weight category. His interest in sport ranged over hunting, flat racing, steeplechasing, coursing, deerstalking, and yachting. Lonsdale was born in London. In his youth, he was one of Britain's best amateur boxers. In 1878, he knocked out John L. Sullivan, the world heavyweight champion, in a friendly sparring contest. He became a member of the Royal Yacht Squadron and won many races. In 1888 and 1889, Lonsdale visited the North American Arctic. His party found gold deposits in Alaska. This discovery confirmed earlier finds and led to the Klondike gold rush.

Lonsdale, Dame Kathleen (1903-1971), an Irish-born chemist, specialized in the field of X-ray crystallography. The object of her work was, in her own words, to "study the way in which atoms are put together." In 1968, she became the first woman president of the British Association for the Advancement of Science. She was a noted pacifist and Quaker. Kathleen Lonsdale was born at Newbridge, in County Kildare, and educated at Bedford College, London. She became professor of chemistry and head of the department of crystallography at University College, London. In 1960, she became the first woman vice president of the Royal Society.

Dame Kathleen Lonsdale

Lonsdale, William (1800?-1864), served the Australian city of Melbourne in many ways during its first 18 years. In 1837, Governor Bourke appointed him first police magistrate at Port Phillip. Lonsdale chose the site for the official centre of the settlement, which was named Melbourne. In 1840, he was appointed subtreasurer of Port Phillip. He became acting mayor of Melbourne in 1842 and served as superintendent of the settlement in 1846 and 1847. When Victoria became a separate colony in 1851, Lonsdale became first colonial secretary. In 1853 he became colonial treasurer.

Lonsdale was born in Britain and arrived in Sydney in 1831 as a lieutenant in the British army. He returned to Britain in 1854.

See also **Melbourne** (History).

Loom. See **Weaving; Textile.**

Loon is a type of water bird with a sleek body for swimming and diving. Loons have a short tail and webbed feet and look somewhat like large ducks when sitting on water. Loons use their dagger-shaped bill to catch fish. They sometimes are called *divers* and can feed in deep water.

There are four species of loons, all of which live in the northern part of the Northern Hemisphere. The *common loon,* also called the *great northern diver,* is found during the summer on secluded lakes and rivers from the Northern United States to the Arctic Circle. Common loons measure about 75 centimetres long. Their backs and wings are black with white spots.

The head and neck are glossy black and green, and the neck has white streaks. Their strange laughing calls echo over water at night and gave rise to the saying "crazy as a loon."

The *yellow-billed loon* looks much like the common loon but is somewhat larger. It lives only in the Far North. The *arctic loon* has a purple-black throat. The *red-throated loon,* also called *red-throated diver,* has an upturned bill and dull brown feathers, except for the throat.

Scientific classification. Loons belong to the loon family, Gaviidae. The common loon is *Gavia immer.* The yellow-billed loon is *G. adamsii;* the arctic loon, *G. arctica;* and the red-throated loon, *G. stellata.*

See also **Bird** (picture: Birds of inland waters and marshes).

Looper. See **Measuring worm.**

Loosestrife is any one of a group of more than 70 plants that belong to the primrose family. *Yellow loosestrife,* native to Europe and Asia, grows in damp places. It has sword-shaped leaves and yellow flowers. *Creeping Jennie* thrives in moist soils. It grows as a creeping vine and bears paler yellow, bell-like flowers. Purple loosestrife grows by the sides of ponds and rivers. It has reddish purple or pink flowers arranged in dense flower spikes.

Scientific classification. Loosestrife belong to the primrose family, Primulaceae. Yellow loosestrife is *Lysimachia vulgaris,* creeping jenny is *L. nummularia,* and purple loosestrife is *Lythrum salicaria.*

Lope de Vega. See **Vega, Lope de.**

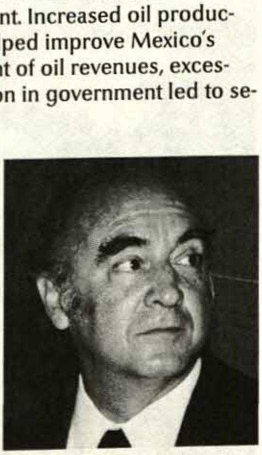
López, Carlos Antonio and **Francisco Solano.** See **Paraguay** (Independence; Military ruin).

López de Santa Anna, Antonio. See **Santa Anna, Antonio López de.**

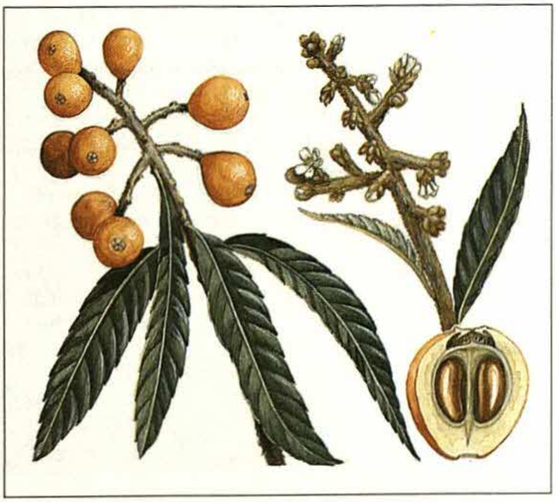
López Portillo, José (1920-), served as president of Mexico from 1976 to 1982. López Portillo, a member of the Institutional Revolutionary Party, ran unopposed in the 1976 presidential election. As president, he supported economic programmes to encourage investment in private business in Mexico in order to increase economic growth and employment. Increased oil production at the start of his term helped improve Mexico's economy. But mismanagement of oil revenues, excessive borrowing, and corruption in government led to severe economic problems.

López Portillo was born in Mexico City. He received a law degree from the National Autonomous University of Mexico in 1946. He taught college courses in law, political science, and public administration from 1947 to 1958. In 1959, he became an adviser in the government's Ministry of National Patrimony.

During the 1960's, López Portillo held increasingly important positions in the Mexican government. In 1970, he was named undersecretary of national patrimony. In 1973, López Portillo became secretary of finance and public credit.



José López Portillo



Loquats are small egg-shaped fruits with a slightly tart flavour. The fruits grow in clusters on the loquat tree, a small evergreen.

Loquat is an orange or yellow fruit that has the shape and size of an egg. It is a type of fleshy fruit called a *pome* and contains many seeds inside a papery core. The loquat tree is an evergreen that grows from 5.5 to 7.5 metres high. It is grown extensively in Japan. Today, it is also grown commercially in the United States. The loquat is also grown as a garden fruit tree in Australia, the Mediterranean region, along the Mexican Gulf Coast, and in South America.

Loquat fruit is soft and bruises easily when mature. Loquats have a mildly tart flavour. They are eaten fresh, cooked, and as a jelly.

Scientific classification. The loquat tree is in the rose family, Rosaceae. It is *Eriobotrya japonica.*

Loran stands for *lo*ng *ra*nge *n*avigation. It is a system of radio navigation that helps ships and aircraft find their positions. Two or more stations, known as the *master* and the *slave* stations, continually send out radio signals. The ship or aircraft receives these signals with special equipment. The equipment measures the time interval between the pulses it receives from the stations. The difference in time between receiving the signals from one pair of stations places the ship or aircraft at some point on a *loran line of position* on a chart. The chart is marked to show the position of the ship or aircraft according to the difference in time between the signals from the two stations.

In most cases, a single master station is paired with each of two slave stations. This arrangement allows the navigator to *intersect* (cross) two loran lines of position to fix a ship or aircraft's position and so greatly improve the accuracy of the system.

Navigators use a system known as loran-C. Loran-C can transmit its signal more than 1,600 kilometres during the day. Under certain conditions, it has a range of more than 4,800 kilometres at night, when low-frequency radio waves travel farther. A position can be located within approximately 0.5 kilometre.

See also **Navigation** (Loran); **Shoran.**

Lorca, Federico García. See **García Lorca, Federico.**

Lord is a title added to a person's name or to his office in Great Britain. Great Britain's House of Lords includes the peers, called *lords temporal*, and dignitaries of the Church of England, called *lords spiritual*. The word *lord* is often used as a less formal title for a marquess, earl, or viscount, and always for a baron. The younger sons of dukes and marquesses have the title added to their names. The word *lord* is also used with the names of bishops (the lord bishop of London) and government offices (lord lieutenant of Ireland).

Lord, Simeon (1770-1840), was an Australian pioneer merchant who became one of the wealthiest people in New South Wales during the early years of its settlement. Lord was the first person to weave cloth from Australian wool. In his mills at Botany Bay, Lord manufactured coarse cloth, blankets, stockings, and hats from locally produced wool.

Lord was born in Rochdale, England. He was transported to Australia in 1791 for theft, and served seven years as a convict.

Simeon Lord

In 1800, Lord bought a trading ship. He also practised as a public auctioneer and estate agent. He soon became one of the colony's leading businessmen. He supplied the government with local and imported articles, and traded with such cargoes as coal, cedar, sandalwood, and sealskins, using his own ships. In 1803, he took advantage of the short-lived peace between Britain and France to import rum from Mauritius, a French colony. In 1810, he was appointed a magistrate. But Commissioner John Thomas Bigge claimed that Lord was unsuitable and, in 1820, forced Lord to resign (see **Bigge, John Thomas**).

Lord chamberlain is the most important officer in the British royal household. He is appointed by the monarch on the advice of the prime minister. His duties include appointing doctors, surgeons, and senior servants to the royal household. He also helps to organize coronations and the christenings, marriages, and funerals of members of the royal family. For many years, the lord chamberlain issued licences for all new plays to be shown to the British public. He could censor any passages he found objectionable, and could even ban plays. His licensing and censorship powers were abolished in 1968.

Lord chancellor is the head of the judiciary in Britain. He is a member of the Cabinet and of the Privy Council by virtue of his office. Because of his judicial functions, he is usually a barrister, and by custom is a peer (see **Peer of the realm**). The lord chancellor has various judicial duties and is a legal adviser to the monarch. He sits as a lord of appeal in the House of Lords. He recommends people for appointment as judges in the High Court and elsewhere. He is appointed by the monarch on the advice of the prime minister and goes out of office when his party loses power.

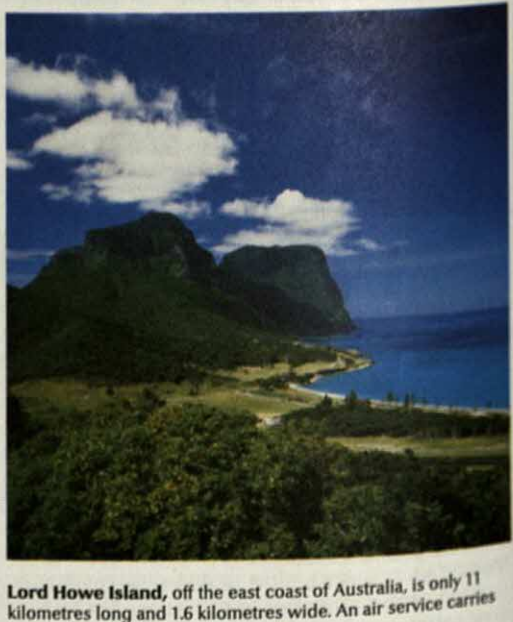
The lord chancellor sits on the woolsack in the House of Lords and acts as chairman (see **Woolsack**). He may take part in debates and speak for the government. The lord chancellor is also keeper of the Great Seal. His official title is *Lord High Chancellor of Great Britain* (see **Great Seal**).

Lord chief justice is the highest judicial officer after the lord chancellor in England, Wales, and Northern Ireland. The lord chief justice presides over the Queen's Bench Division of the High Court of Justice. The monarch appoints the lord chief justice on the advice of the prime minister. William the Conqueror appointed a *justiciar* to preside in the King's Court and to have overall control of the other courts. The office of justiciar disappeared in the late 1200's. But, in the late 1500's, the senior judge of the King's Bench began to use the title *Lord Chief Justice*.

Lord Howe Island (pop. 320) is a volcanic island off the eastern coast of Australia, almost 650 kilometres northeast of Sydney. It is a dependency of New South Wales. Its area is 1,303 hectares.

Lieutenant Henry Lidgbird Ball, commander of the *Supply*, visited Lord Howe Island in 1788 on his way to Norfolk Island from Port Jackson. He named it in honour of Lord Howe, a British admiral. The first Europeans and Maoris landed there in 1834.

Lord lieutenant is the principal officer of a county in Great Britain. The prime minister appoints him to act as the monarch's representative. The lord lieutenant is also responsible for recommending to the lord chancellor people to sit as justices of the peace on the county bench of magistrates. He can appoint deputy lieutenants, who must have served for 10 years in the armed services, or have given outstanding service to their county. The post of lord lieutenant was created by Henry VIII. A lord lieutenant was then responsible for his county's military manpower. He commanded the militia, yeomanry, and volunteers, and appointed their officers.



Lord Howe Island, off the east coast of Australia, is only 11 kilometres long and 1.6 kilometres wide. An air service carries tourists from Sydney to the island.

The Lord Mayor's Show, a colourful procession through the City of London, features the lord mayor in a coach, *left.* The show takes place each November.

Lord mayor is the honorary title given the chairman of certain borough councils in Great Britain. Local government districts that have received their borough status by royal charter have lord mayors. The monarch may also designate these districts as cities. For this reason, some cities and boroughs in Britain have elected lord mayors.

The work of the lord mayor does not differ from that of an ordinary mayor. Both serve as presiding officers of their councils, supervising council meetings and keeping order. But both mayors and lord mayors have many ceremonial duties and take part in civic functions, from entertaining foreign dignitaries to opening church fêtes. For many of these civic duties, the mayor or lord mayor wears special robes and a chain of office.

London's lord mayor, one of the best-known officials in Britain, is chairman of the Corporation of the City of London. Each November, after being elected, the new lord mayor takes part in the Lord Mayor's Show, a colourful procession through London's streets. In this show, the lord mayor is presented for the approval of the sovereign and the people of London and travels in state to the Royal Courts of Justice to make a declaration of office before the lord chief Justice and other judges representing the monarch. This ceremony, which dates from 1215, used to take place on the River Thames. At the Banqueting Hall, the lord mayor gives a banquet attended by the City of London's businesspeople. One of London's most famous lord mayors was Dick Whittington (see **Whittington, Dick**).

Lord Protector. See **Cromwell, Oliver.**

Lords, House of. See **House of Lords.**

Lord's Prayer is the most widely said Christian prayer. By tradition, it is one of the three basic statements of Christian faith. The other two are the Apostles' Creed and the Ten Commandments. For over 1,000 years, people who have been raised as Christians or have become Christians have memorized the Lord's Prayer.

The Lord's Prayer is also called the *pater noster,* two Latin words meaning *Our Father,* the first two words of the prayer. The prayer appears in two forms in the New Testament—in Matthew 6: 9-13 and in Luke 11: 2-4. Protestants and Roman Catholics now both use the longer form from Matthew.

The Lord's Prayer praises God, asks for food and forgiveness, and pleads for protection against evil. Both Gospels tell that Jesus taught the prayer to His followers as the best way to pray to God. Many scholars believe the prayer expresses the religion that Jesus taught His followers and wanted them to practise.

In the King James, or Authorized, version of the prayer, the line "Forgive us our debts" is in Matthew, and "Forgive us our sins" is in Luke. A third version of the prayer uses "Forgive us our trespasses." The words *debts, sins,* and *trespasses* all are translations from the same word used in the original Greek version. The Greek word means *to miss the mark.*

All Christian denominations say the Lord's Prayer, both in public worship and in private prayers. The prayer is also said by nonreligious groups, including athletic teams before or after games and organizations at meetings. Many composers have set the prayer to music.

Lord's Supper. See **Communion.**

Lorelei is a high cliff that towers about 130 metres above the Rhine River between Mainz and Koblenz in Germany. At that point, the river is swift and dangerous. Legend says the echo heard at the Lorelei is the voice of a beautiful but wicked siren, or river nymph, luring boatmen to destruction. The siren is also called Lorelei. The German writer Clemens Brentano may have invented the myth in 1802.

See also **Rhine River.**

Lorentz, Hendrik Antoon (1853-1928), was a Dutch physicist. He became famous for his electron theory of matter, and shared the 1902 Nobel Prize for physics with Dutch physicist Pieter Zeeman for discovering the effects of magnetism on light (Zeeman effect).

Lorentz assumed that matter consists of electrically charged particles. His electron theory showed that moving bodies would appear to be shortened in the direction of motion. This was because forces between charged particles could be affected by motion, making the length of the bodies appear different when measured at rest. The change in length is too small to notice except in precise experiments that are carried on at high speeds.

The equations that show how bodies are deformed by motion are called the *Lorentz transformations.* Lorentz' theory predicted effects similar to those predicted by Einstein's theory of relativity (see **Relativity** [picture]). Lorentz was born at Arnhem, the Netherlands, and graduated from Leiden University.

Lorenz, Konrad Zacharias (1903-1989), an Austrian naturalist, was one of the founders of *ethology,* the study of animal behaviour. Lorenz and two other ethologists—Karl von Frisch of Austria and Nikolaas Tinbergen, born in the Netherlands—received the 1973 Nobel Prize for physiology or medicine for their work on animal behaviour.

Unlike psychologists, who had studied animal behaviour in laboratories, Lorenz studied animals in their natural environments. He also reared wild creatures in his home. He observed that instinct plays a major role in animal behaviour—a view that conflicted with the ideas of many psychologists. He described the instinctive process of *imprinting,* by which, for example, an animal may learn to identify its owner as its parent (see **Instinct** [Imprinting]).

Lorenz was born in Vienna. He earned an M.D. degree in 1928 and a Ph.D. degree in 1933, both at the University of Vienna. In 1954, he became codirector of the Max Planck Institute for Physiology of Behaviour in Germany.

Lorenz wrote several books. *King Solomon's Ring* (1952) describes his experiences with animals. In *On Aggression* (1966), he compares aggressive behaviour among animals to the actions of human beings.

See also **Ethology.**

Lorenzini, Carlo. See **Collodi, Carlo.**

Lorenzo the Magnificent. See **Medici.**

Loris is a slow-moving animal that lives in trees. Lorises are *primates,* members of the order of animals that includes monkeys, apes, and human beings. The *slender loris* lives in India and Sri Lanka. The larger *slow loris* is found from India to Indonesia.

Most lorises are grey or brown and grow 20 to 25 centimetres long. Their three-cornered faces and large eyes give them a weird appearance that helps to frighten away predators. The slender loris has no tail. The slow loris has a short, stumpy tail, hidden by fur.

The loris lives alone most of the time. The animal sleeps in the daytime with its feet clasped around the limb of a tree, and its body rolled into a ball with the head tucked between the thighs. During the night, the loris prowls around in search of food. The loris lives on fruit, insects, young birds, and bird's eggs.

Scientific classification. Lorises belong to the loris family, Lorisidae. The slender loris is *Loris tardigradus.* The slow loris is *Nycticebus coucang.*

Lorne, Marquess of (1845-1914), served as governor general of Canada from 1878 to 1883. In 1880, he helped establish an office in London called the office of high commissioner of Canada to improve communications between the Canadian and British governments. In 1882, he founded the Royal Society of Canada, which promotes the arts and sciences. Lorne also helped found the Royal Canadian Academy of Arts and the National Gallery of Canada.

Lorne was born in London. His name was John Douglas Sutherland Campbell. In 1871, he married Princess Louise Caroline Alberta, a daughter of Queen Victoria.

Lorne was elected to the British Parliament in 1868. He served in the House of Commons as a member of the Liberal Party until 1878. He also served in the House of Commons as a Unionist from 1895 to 1900. Lorne became the ninth Duke of Argyll in 1900.

Lorrain, Claude. See **Claude.**

Lorraine. See **Alsace-Lorraine.**

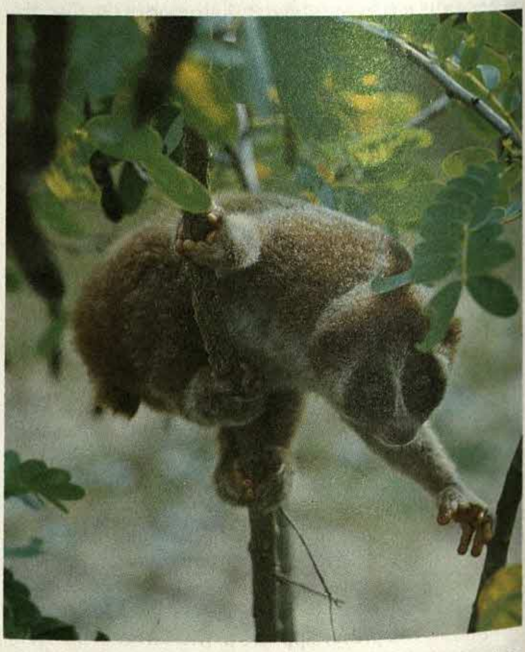
Lorry. See **Truck.**

Lory. See **Parrot** (Kinds).

Los Alamos National Laboratory, in Los Alamos, New Mexico, is one of the world's leading research institutions. It is primarily involved in the application of science and technology to problems of United States national security. Activities at the laboratory include the development of nuclear warheads, the production and testing of nuclear materials, and the creation of designs for new weapons. The laboratory is also responsible for developing technology for use in verifying that other nations fulfill their arms control commitments. Other research at the laboratory focuses on such areas as nuclear physics, the U.S. energy supply, and the disposal of nuclear waste.

The University of California operates Los Alamos National Laboratory for the United States Department of Energy. The Los Alamos National Laboratory was established in 1943 as part of the World War II Manhattan Project to build the first nuclear weapons (see **Manhattan Project**).

Today, more than 3,500 scientists, engineers, and other professionals work at the laboratory. It contains some of the largest and fastest computers in the world. Its Clinton P. Anderson Meson Physics Facility (LAMPF) houses a proton linear accelerator that is 0.8 kilometre long. Many scientists consider LAMPF to be the most sophisticated nuclear science facility in the world.



The slow loris, *above,* is found from India to Indonesia. Lorises live in trees and are active at night. These small animals use their hands and feet to grasp branches while climbing.

Los Angeles city centre is ringed by high-speed roads. The people of Los Angeles depend heavily on their cars to travel about their sprawling city. Los Angeles is the chief business, financial, and trade centre of the Western United States.

Los Angeles

Los Angeles is a huge city in southern California, in the United States. The 1982 U.S. Bureau of the Census estimates reported that Los Angeles had passed Chicago in population and had become the nation's second largest city, after New York City. Few cities in the United States have grown as rapidly as Los Angeles. In 1850, when Los Angeles became a city, it had only 1,610 people. In 1940, with a population of about $1\frac{1}{2}$ million, it was the nation's fifth largest city. Today, Los Angeles has about $3\frac{1}{2}$ million people.

Los Angeles is the seat of Los Angeles County, the nation's largest county in population. The county has about 9 million people and includes 80 other cities besides Los Angeles. Los Angeles County makes up the city's metropolitan area. Los Angeles and other communities in the area run together and look much alike, making it difficult to tell where one community ends and another begins. For this reason, the area has been described as "a hundred suburbs in search of a city."

More than half the people of Los Angeles County moved there from other parts of the United States or from other countries. Many immigrants moved to Los Angeles seeking good jobs or to escape from political conflicts in their countries. Some people were attracted by the city's scenic location, pleasant climate, and outdoor way of life.

Golden beaches line the Pacific Ocean to the west and south of Los Angeles, and tall, snow-capped mountains rise to the northeast of the city. The ocean and the mountains help give Los Angeles a mild climate throughout the year. The climate is mostly warm, therefore it is possible for people to take part in most outdoor sports throughout the year. Most of the homes in Los Angeles have gardens with patios, and many also have swimming pools.

Each year, millions of tourists visit the Los Angeles area. They come to enjoy the area's beaches, ski resorts, and other recreational facilities, as well as its many cultural and entertainment attractions.

Los Angeles is the industrial, financial, and trade centre of the Western United States. It is also the largest manufacturing centre in the country. It leads the nation in the production of aircraft and equipment for space exploration. The city's film and television industry is world famous. Banks and other financial institutions in Los Angeles rank among the largest in the country and have helped finance the area's rapid growth. The Port of Los Angeles is one of the busiest ports on the West Coast. Each year, thousands of cargo ships, fishing boats, and pleasure craft dock at this port.

But with all its glories, Los Angeles has serious problems. Many of them result from the rapid increase in population. The city has little open land left, and housing—especially low-cost housing—is in short supply. The people depend mainly on cars for transportation, and they own more than 5 million cars. The main road system is often jammed, and exhaust fumes—as well as smoke from factories—have created a grave air pollution problem. To help reduce air pollution, Los Angeles has improved its bus system and experimentally introduced methanol-powered buses. To ease traffic congestion, construction of an underground railway system was begun in the mid-1980's.

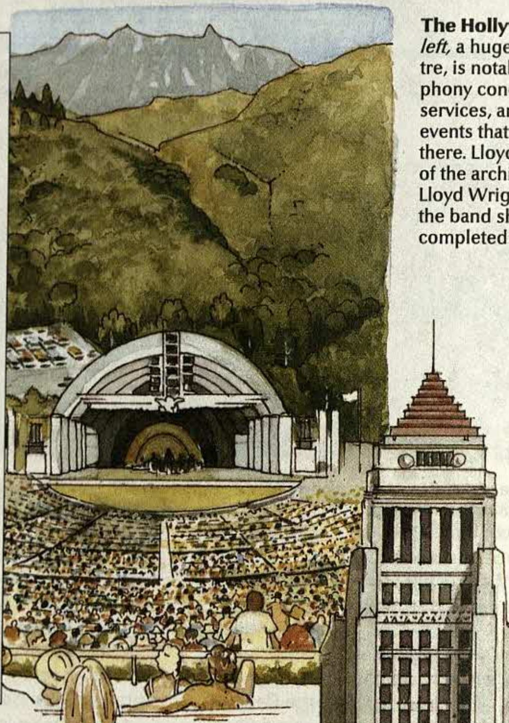
Facts in brief about Los Angeles

Population: *City*—3,485,398. *Metropolitan area*—8,863,164.
Area: *City*—1,207 km². *Metropolitan area*—10,653 km².
Altitude: 84 m above sea level.
Climate: *Average temperature*—January, 13 °C; July, 23 °C. *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—38 cm.
Government: Mayor-council. *Terms*—4 years for the mayor and the 15 council members.
Founded: 1781. Incorporated as a city in 1850.

Los Angeles *The City of Angels: A sprawling complex of commerce and recreation.*

Lies in southern California on Pacific Ocean. Second largest U.S. city (pop. 3,485,398). Known for pleasant climate, outdoor way of life, and scenic views among beaches and mountains. Business, financial, and trade centre of Western United States. Known throughout world for film and television industry. Outstanding recreational facilities and cultural attractions.

Los Angeles has history of annexing nearby cities and towns. Today, one of nation's largest cities in area (1,207 km²). To serve people's need to travel by car, elaborate expressways were built. They are often jammed, and exhaust fumes from cars have created serious air pollution problem.



The Hollywood Bowl, *left,* a huge open-air theatre, is notable for its symphony concerts, Easter services, and other public events that take place there. Lloyd Wright, son of the architect Frank Lloyd Wright, designed the band shell. It was completed in 1929.

The Griffith Observatory, *below,* is a major attraction of Griffith Park. The park covers more than 1,600 hectares.

City Hall, *right,* one of the city's best-known landmarks, stands in the heart of central Los Angeles. The structure has 30 floors, including the ground floor, and is part of a group of government buildings that comprise the Civic Center.

1500's
Shoshonean Indians lived in a village called Yang-na near what is now central Los Angeles.

1542
Juan Rodríguez Cabrillo, a Portuguese explorer working for Spain, encountered Shoshonean Indians.

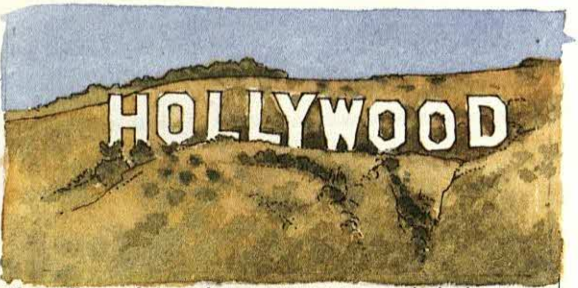
1769
Spanish explorers visited the area. As a result, Spain began to colonize area.

1771
Franciscan priests built Mission San Gabriel Arcángel.

1781
Settlers from Mexico founded Pueblo of Los Angeles.

1821
Mexico won independence from Spain, took control of Los Angeles.

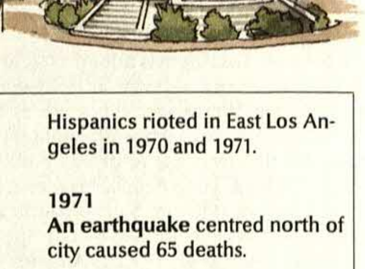
Many important communities in and around Los Angeles. Expensive homes of film and television stars, glitzy shops of Rodeo Drive lie in Beverly Hills. Burbank is home to Walt Disney and Warner Brothers studios.



The Hollywood sign, *above,* on Mount Lee, overlooks the famous film district.

The J. Paul Getty Museum, *above,* houses the magnificent art collection of the United States billionaire J. Paul Getty (1892-1976). The building itself was modelled after an Ancient Roman villa.

The Old Plaza, *below,* is a charming public square in *El Pueblo de Los Angeles Historic Park.* Pioneers from Mexico founded Los Angeles there in 1781. The Pueblo resembles a village of old Mexico.



Disneyland, *right,* is a world famous theme park near Los Angeles. The film producer Walt Disney (1901-1966), creator of such celebrated cartoon characters as Mickey Mouse and Donald Duck, opened the park in 1955. Most of the attractions at the park are based on Disney characters.

1841
First American settlers arrived in the area.

1850
Los Angeles was incorporated as an American city.

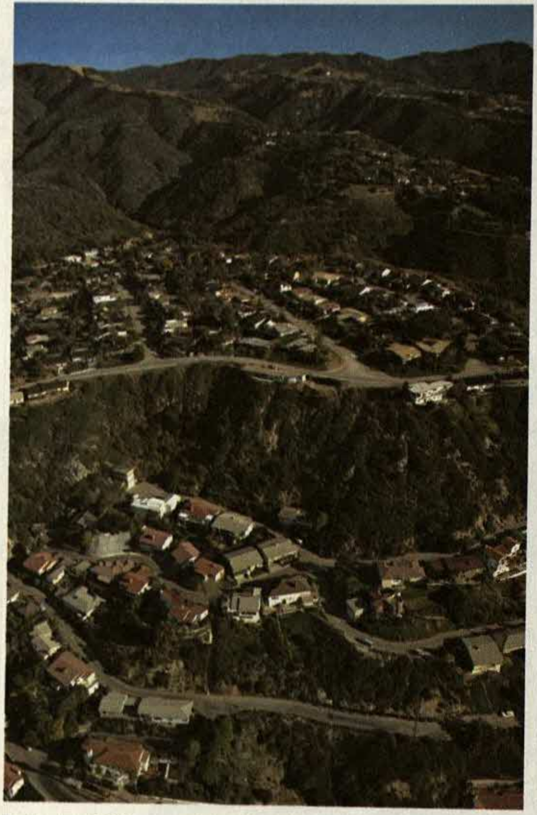
1885
Santa Fe Railroad linked Los Angeles with Midwest. People flocked to area from East and Midwest.

1914
First section of breakwater at San Pedro was completed. City developed into a major seaport.

1965
Blacks in the Watts district of south-central part of city rioted. Hispanics rioted in East Los Angeles in 1970 and 1971.

1971
An earthquake centred north of city caused 65 deaths.

1984
The Summer Olympic Games were held in Los Angeles.



Hollywood Hills is a residential section of Hollywood, one of Los Angeles' most glamorous districts. Homes in Hollywood Hills extend far up the slopes of the Santa Monica Mountains.

City

Los Angeles lies on the Pacific coast in southern California. It is about 563 kilometres southeast of San Francisco and about 209 kilometres northwest of San Diego and the Mexican border. Los Angeles covers 1,204 square kilometres, making it one of the nation's largest cities in area. It stretches about 80 kilometres from the San Fernando Valley in the north to Los Angeles Harbor at San Pedro Bay in the south. From east to west, the city extends about 48 kilometres— from the San Gabriel Mountains to the Pacific Ocean.

In the past, Los Angeles added to its area by annexing such nearby cities and towns as Hollywood, San Pedro, Van Nuys, and Westwood. These places are now districts of Los Angeles. Eighty independent communities lie outside the city in Los Angeles County. These cities include Burbank, Long Beach, Pasadena, and Santa Monica. Beverly Hills and San Fernando are independent communities surrounded by Los Angeles.

Metropolitan area. The Los Angeles metropolitan area, as defined by the federal government, covers all of Los Angeles County. The area is officially known as the *Los Angeles-Long Beach Metropolitan Statistical Area.* It has about 9 million people and ranks as the nation's second largest metropolitan area, behind only the New York City metropolitan area.

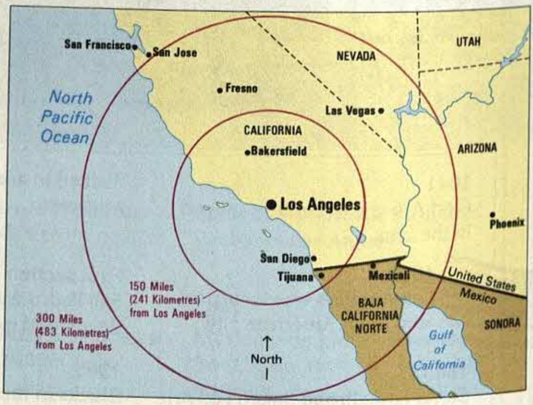
An area commonly called *Greater Los Angeles* is even larger than the official metropolitan area. Greater Los Angeles takes in part of San Bernardino County, east of Los Angeles, and part of Orange County, which lies southeast. Many of the people who live in these counties work in Los Angeles. More than 10 million people live in Greater Los Angeles. Only seven states—including California—have larger populations.

The communities in the Los Angeles metropolitan area blend together so that, in many cases, it is difficult to tell one from another. As a result, the entire metropolitan area is often referred to as simply Los Angeles. Many of the famous features and tourist attractions that people from other parts of the country think are in Los Angeles are actually outside the city.

The most important suburban communities north and east of Los Angeles include Burbank, Glendale, and Pasadena. The Walt Disney and Warner Brothers studios are in Burbank, and the National Broadcasting Company (NBC) has its West Coast headquarters in the city. Glendale includes famous Forest Lawn Memorial Park, an elaborately landscaped cemetery filled with statues and other works of art. Pasadena is known for its Tournament of Roses, held each New Year's Day. The tournament consists of a parade of flower-covered floats, followed by a game of American football in the Rose Bowl stadium. Each year, the champions of the Big Ten and the Pacific Ten, two of the nation's top college conferences, compete in the Rose Bowl game.

Beverly Hills, which lies west of the Hollywood district, is almost completely surrounded by Los Angeles. It is a fashionable community of expensive homes, many of which belong to film and television stars. Santa Monica, an attractive residential and resort city, lies southwest of Beverly Hills along the Pacific Ocean. It is the site of McDonnell Douglas Corporation, one of the nation's largest aircraft manufacturers. Culver City has the Metro-Goldwyn-Mayer film studios.

The residential towns of Gardena and Torrance lie west of the strip of Los Angeles that connects the Port of Los Angeles with South-Central Los Angeles. The Palos Verdes Peninsula juts into the Pacific Ocean south of Torrance.



Los Angeles lies in southern California between San Francisco and the Mexican border. A number of well-known North American cities lie within 500 kilometres of Los Angeles.

People

Through the years, large numbers of people from other parts of the United States and the world have settled in Los Angeles. People of Latin-American, black, or Asian ancestry make up about two-thirds of the city's population. Most of the rest of the people are of European ancestry. They include people of English, German, Irish, Italian, and Russian descent. Roman Catholics make up the city's largest religious group. Other large religious groups include Christian Scientists, Episcopalians, Jews, Lutherans, and Methodists.

Ethnic groups. Hispanics account for about 40 per cent of Los Angeles' population. People of Mexican ancestry make up the largest Hispanic group by far. Los Angeles has about 800,000 Mexican Americans, more than any other U.S. city. Most of them were born in the United States. But many others moved to the city from Mexico in search of higher-paying jobs and a better life. The city's Hispanic population also includes people from—and descendants of people from—Cuba, Puerto Rico, and the countries of Central America. Most of the city's Mexican Americans and other Hispanics live in the overcrowded, run-down barrio of East Los Angeles. But there are also barrios in the San Fernando Valley and other sections of the city. Discrimination, a lack of education, and the inability to speak English prevent many Hispanics from finding well-paying jobs and leaving the barrios.

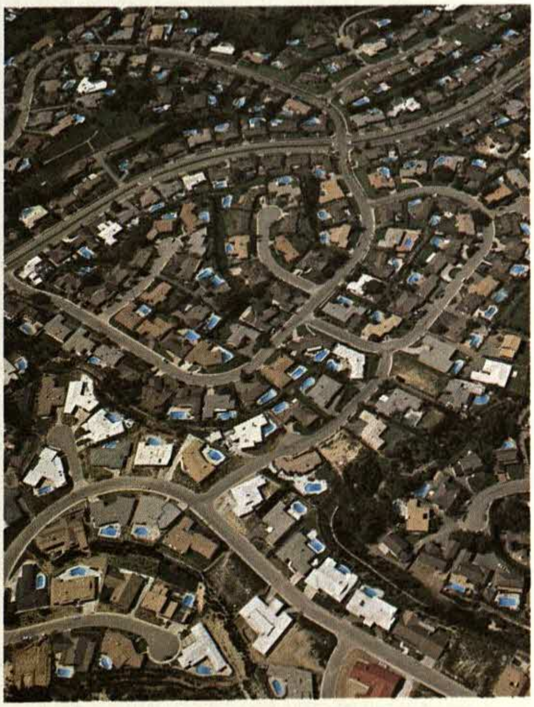
Blacks make up about 14 per cent of the population of Los Angeles. The city has about 500,000 blacks. Most of them live in South-Central Los Angeles. Many have been prevented from leaving this area by poverty, a lack of education, and discrimination in jobs and housing. But many other blacks live in integrated parts of the city and its suburbs. In fact, more blacks live in suburban areas of Los Angeles than in those of any other U.S. city.

People of Asian ancestry make up 10 per cent of the city's population, or about 340,000 people. The largest Asian groups, in order of size, are Filipinos, Japanese, Chinese, and Koreans. Asians live in various parts of the city, and they have better opportunities for higher education and good jobs than Hispanics and blacks do. But the Asian population once had much the same problems of poverty and discrimination that Hispanics and blacks now face.

Housing. Before the 1960's, most of the housing in Los Angeles consisted of single-family bungalows, cottages, and ranch-style homes. Land in the area had been plentiful and inexpensive. Developers could buy large sections of land, build hundreds of houses at one time, and sell the homes at low prices. The construction of single-family housing developments reached its peak during the 1940's and 1950's. In such areas as the San Fernando Valley, many thousands of homes were built on land that was once covered by orange groves and farms.

By the 1960's, Los Angeles had little vacant land left—and that land was expensive. In addition, the cost of labour and materials had increased greatly. As a result, the majority of new single-family homes were more expensive than most families could afford. Builders then began to construct more apartment houses.

In 1962, for the first time in the city's history, more apartments were built than single-family houses. Since 1962, builders have continued to construct more apartment buildings than houses.



The San Fernando Valley has over a third of Los Angeles' residents. Most of them live in single-family homes with a barbecue in the back garden. Many homes also have a swimming pool.

Social problems. The chief social problems in Los Angeles, as in most other large U.S. cities, include poverty, and racial and ethnic conflicts. Los Angeles has one of the highest standards of living of any city in the nation. Yet many thousands of Los Angeles' residents do not share in the city's wealth. Most of these people are blacks who live in the ghettos of South-Central Los Angeles and Mexican Americans and other Hispanic Americans who live in the barrios of East Los Angeles and other parts of the city.

The people of the ghettos and barrios have similar problems. They live in run-down, overcrowded homes and have little education. Many have difficulty finding work, and others have low-paying jobs. Many students quit school, and crime is widespread. Many people in the barrios speak only Spanish. This limits their opportunities for jobs and education.

Conditions in the ghettos and barrios of Los Angeles have led to serious riots. In 1965, blacks in the Watts district of South-Central Los Angeles rioted for five days. The rioting resulted in 34 deaths and about 40 million U.S. dollars in property damage. In 1970 and 1971, riots by Hispanics in East Los Angeles caused 4 deaths and more than 1 million U.S. dollars in damage. Rioting in 1991 brought about 58 deaths. National Guardsmen were called in to restore order.

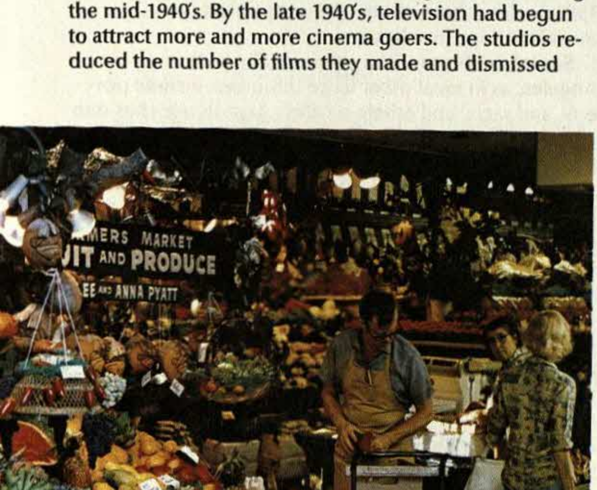
The local, state, and federal governments have taken action to help blacks and Hispanics in Los Angeles. Job-training courses have been set up to teach unskilled workers. Spanish-speaking teachers have been assigned to barrio schools, and black and Hispanic studies have been introduced in ghetto and barrio schools. Legal aid programmes have been set up to help minority group members who feel they have been discriminated against in seeking a job or a place to live. But progress has been slow, partly because poor, unskilled people have continued to pour into the already overcrowded ghettos and barrios.

Economy

Los Angeles ranks as the most important centre of industry, trade, and finance in the Western United States. The city's economy, like its population, has grown rapidly since World War II. Since the end of the war in 1945, the number of jobs in the Los Angeles area has increased greatly. During this period, a large number of new industries, financial institutions, and trading facilities moved into the Los Angeles area and existing ones expanded.

Industry. Los Angeles is the largest manufacturing centre in the United States. The city's largest industry is the aerospace industry. This industry involves the manufacture of aircraft, spacecraft, and related parts and equipment. The Los Angeles area has almost 18,000 factories, and about 2,000 of them are engaged in aerospace production. The giant aerospace industry has attracted more engineers, mathematicians, scientists, and skilled technicians to Los Angeles than to any other city in the United States.

Los Angeles—especially the Hollywood district—has long been known as the film capital of the world. Film-making reached its peak in the Los Angeles area during the mid-1940's. By the late 1940's, television had begun to attract more and more cinema goers. The studios reduced the number of films they made and dismissed many of their employees. In time, the studios became increasingly involved in making films for television.



Farmers Market is located near Hollywood. More than 100 shops and stalls sell a wide variety of goods from alfalfa juice to Hawaiian sportswear.

Los Angeles has rich deposits of petroleum, which is pumped from wells scattered throughout the area. The city's petroleum industry dates back to the late 1800's, when the first wells were drilled. In addition to producing petroleum, the city ranks as one of the nation's top oil-refining centres. It is also a major manufacturer of oil-field equipment.

Other important industries in Los Angeles produce a wide range of products. The city is a leading producer of cars, clothing, computers, furniture, rubber, and tyres. Other manufactured products include chemicals, electric equipment, glassware and pottery, iron and steel, toys, and caravans. The construction industry and printing and publishing are also important. The Los Angeles area is also a major centre of the music-recording industry and has more than 50 record companies.

The Port of Los Angeles is one of the nation's chief fishing ports and one of the largest fish-canning centres in the world. Every day, hundreds of fishing boats bring in huge catches of halibut, sea bass, tuna, and other fishes.

Trade. The Port of Los Angeles handles more ships than any other United States port on the Pacific Coast. The cargo it handles includes foreign imports and exports, as well as goods going to or coming from other U.S. ports. Most of the trade between the United States and Japan flows through the Port of Los Angeles. The port also handles much of the nation's trade with Australia, Canada, Mexico, South America, and Southeast Asia. Large amounts of domestic and international cargo are also handled daily at Los Angeles International Airport.

Tourism. Millions of tourists come to southern California every year. Most of them visit the Los Angeles area and contribute millions of dollars to the city's income. The tourist industry supports hotels, motels, and restaurants, as well as cultural and recreational facilities in the area.

Transportation. Los Angeles residents depend mainly on cars for transportation. The city has one of the world's most extensive *freeway* systems. This 1,050-kilometre network of high-speed motorways runs through Los Angeles, Orange, and Ventura counties. The system consists of a series of overpasses, underpasses, and interchanges. During morning and evening rush hours, slow-moving traffic jams the major highways of the system.

Cultural life and recreation

Los Angeles has long been known for its outdoor way of life. The city's climate and its location along the ocean and near snow-covered mountains enable the people to enjoy most outdoor sports all the year round. But over the years, the people of Los Angeles have also become increasingly interested in cultural matters. As a result, Los Angeles today ranks not only as one of the nation's top recreational centres, but also as one of the leading U.S. cultural centres.

The arts. Los Angeles has two famous open-air theatres. The Hollywood Bowl, which seats more than 20,000 people, is known for its summer concerts and Easter sunrise services. The Greek Theatre, in Griffith Park northeast of Hollywood, presents musical and dramatic programmes. Thousands of actors, artists, musicians, and writers live in Los Angeles. Many of them have been attracted by the area's film and television studios and recording companies.

Recreation. Los Angeles' location and climate make it possible to go surfing or swimming in the ocean in the morning and skiing at a mountain resort that afternoon. The Los Angeles area has about 121 kilometres of beaches along the Pacific, and many ski facilities are located in the Angeles National Forest, northeast of the city. Golf and boating are also popular all year.

History

American Indians were the first people to live in what is now the Los Angeles area. During the 1500's, a branch of the Shoshone tribe lived in a village called Yang-na, near what is now the city centre. In 1769, Gaspar de Portolá, a Spanish Army captain, and Juan Crespi, a Franciscan priest, led an expedition from San Diego north to Monterey Bay. After they reached Yang-na, Crespi wrote that the area had all the features necessary for a large settlement. Crespi and Portolá named the area *Nuestra Señora la Reina de Los Ángeles de Porciúncula,* meaning *Our Lady the Queen of the Angels of Porciúncula.* Porciúncula was a chapel in Italy associated with Saint Francis of Assisi, founder of the Franciscan order of the Roman Catholic Church.

Settlement. Soon after the Portolá party left the site of Los Angeles, Spain began to colonize the area. In 1771, Franciscan priests built Mission San Gabriel Arcángel, just east of the future city of Los Angeles. The mission was one of 21 that the Franciscans built along the California coast. The missions became important agricultural, cultural, and religious centres.

In February 1781, a group of pioneers gathered at Guaymas, Mexico, to begin the long journey to Los Angeles. They arrived on Sept. 4, 1781, and officially founded the Pueblo of Los Angeles.

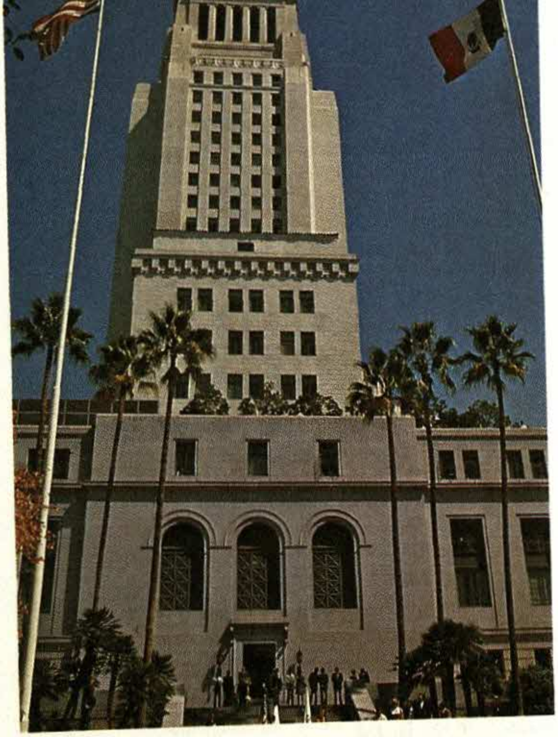
Mexican rule. Los Angeles grew quickly, and by 1800 it had 315 residents. The town began as a farming community, but it soon became a cattle-raising centre. In 1821, Mexico gained its independence from Spain and took control of Los Angeles and the rest of California.

War broke out between Mexico and the United States in May 1846. Mexico lost the war. The Treaty of Guadalupe Hidalgo, 1848, gave the entire California region to the United States.

Development and growth. On April 4, 1850, Los Angeles was incorporated as a city. Five months later, California became a state of the United States. Los Angeles had a population of 1,610 in 1850. With the coming of the railways in 1876, Los Angeles' population soared.

By the 1920's, tourism had become a big business in Los Angeles. The area's new film industry was booming. The oil industry, which had begun in the 1890's, was spurred by the discovery of rich new fields. Also during the 1920's, new aircraft plants opened, and factories began to manufacture furniture, pottery, tyres, and other products.

Recent developments. Los Angeles today is a huge, thriving urban centre. But like other cities, it suffers periodic economic slumps. One of the worst of these slumps began in the early 1990's. Unemployment is high among blacks and Hispanics, and the city has been troubled by ethnic conflicts.



Los Angeles' City Hall stands in the heart of the city centre. The 26-storey landmark is one of a group of city, county, state, and federal buildings that make up the Civic Center.

Air pollution has been a serious problem in Los Angeles since the 1950's. On calm days, smoke from factories and exhaust fumes from cars collect near the ground and form a thick yellow haze called *smog.*

Los Angeles receives little rain. The area's long, hot summers dry the brush and grass in the hills, creating a severe fire hazard in the early autumn. Thousands of Angelenos were made temporarily homeless as wind-driven fires destroyed millions of dollars worth of property along the south California coast in October 1992.

The Los Angeles area lies in a region of earthquake activity. Most of the earthquakes cause limited damage. But in 1971, 1987, and 1992, earthquakes caused deaths and extensive damage. In January 1994, an earthquake centred in Northridge, a northwestern suburb of Los Angeles, caused 55 deaths and an estimated 15 to 30 billion U.S. dollars in property damage.

In 1973, Thomas Bradley became the city's first black mayor. Bradley was reelected in 1977, 1981, 1985, and 1989.

In the early 1990's, police brutality and race relations became major concerns in Los Angeles. Four white police officers accused of assaulting King, a black, were acquitted despite video evidence of the beating. Rioting, looting, and arson broke out, primarily in black areas of South-Central Los Angeles. The riots resulted in 53 deaths, about 2,400 injuries, and over 1 billion U.S. dollars in property damage. In August 1992, the federal government indicted the four police officers on charges that they violated King's civil rights. In April 1993, a federal jury convicted two of the officers on these charges. Both were sentenced to 2½ years in prison. The other two officers were acquitted.

Los Angeles, an airship. See **Airship** (picture: The uses of airships).

Los Negros Island. See **Admiralty Islands.**

Lost Colony is the name given to an English settlement established in 1587 on Roanoke Island, off the coast of what is now North Carolina U.S.A. The colony is called *lost* because no one knows what happened to its people or where they went.

The Lost Colony was England's second colony in America. The first had been established on Roanoke Island by a group of 108 men sent to the island in 1585 by the English soldier and explorer Sir Walter Raleigh. The first colony was meant to serve chiefly as a base for repairing and resupplying English warships. But the colonists found that the seas around the island were too shallow for ships to seek shelter there. In addition, the land was not productive enough to support both the colony and the Indians already living there. As a result, the colonists returned to England in 1586.

A few days after the colonists left, a group of ships sent by Raleigh from England arrived at the island with supplies and more colonists. When the new colonists found that the others had left, most of them sailed back to England with the ships. However, 15 adventurers remained on the island.

In May 1587, Raleigh sent another group of colonists to America, to settle on the shores of Chesapeake Bay. These colonists became the lost colonists. They were led by John White, an Englishman who had been a member of the first colony.

In July 1587, the commander of the ships carrying the new colony refused to sail beyond Roanoke Island and forced the colonists to land there. When the colony landed, it consisted of 117 people—91 men, 17 women, and 9 children. Twenty-seven days later, on August 18, White's daughter, Eleanor, gave birth on the island to a baby girl. Named Virginia Dare, the baby was the first English child born in America. Her father, Ananias Dare, was also one of the colonists. Later in August, White returned to England for supplies.

The following year, 1588, was the year of the Spanish Armada—the Spanish fleet that sailed to invade England. The war between England and Spain prevented White from returning to Roanoke Island until August 1590. By the time he arrived, the colony had been abandoned. The only traces of the colonists were the letters *CRO* carved on one tree and the word *Croatoan* carved on another.

The Croatoan, or Hatteras, Indians were friendly Indians who lived on an island south of Roanoke Island. Although the colonists had intended to go north by land to Chesapeake Bay, White decided to see if they had gone to live with the Croatoans. However, a storm and the lateness of the season forced White and his expedition to return to England. The lost colonists were never seen again by any European.

Some modern historians think that most of the lost colonists may have moved to Chesapeake Bay and perished there in conflicts with Indians. Stories collected by Virginians indicate that other members of the Lost Colony may have mingled with several Indian tribes. The Lumbee Indians, who live in southeastern North Carolina, believe themselves to be descendants of the lost colonists and of Indians who lived nearby.

The main clue to the Lost Colony was the word *Croatoan* carved on a tree. John White left the Roanoke colonists in America and sailed back to England for badly needed supplies. When he returned in 1590, the colonists had completely disappeared. Although there is no proof, some people believe the colonists may have married into an Indian tribe and been forgotten.

Lot, in the Book of Genesis, was the nephew of the patriarch Abraham. The two led their followers from the city of Ur in Mesopotamia to Canaan. There, they divided their company into groups (Gen. 13). Lot resided in the wicked city of Sodom. He unknowingly entertained two angels sent to destroy Sodom and the nearby city of Gomorrah. Later, Lot fled from Sodom with his wife and two daughters. His wife, defying the command they had been given, turned back to watch the destruction of the cities. She was immediately changed into a pillar of salt as punishment for her curiosity and disobedience (Gen. 19:26).

Lot's daughters despaired of finding husbands and therefore having children. They thus got their father drunk and had sexual relations with him. Two sons, called Moab and Ben-ammi, were born as a result. They were considered the ancestors of the Moabites and Ammonites in what is today the East Bank of the River Jordan.

See also **Abraham; Sodom and Gomorrah.**

Lotharingia. See **Verdun, Treaty of.**

Lothian Region was a region of eastern Scotland, south of the Firth of Forth. In April 1996 the region was abolished and replaced by smaller local government areas. The area is dominated by Edinburgh, the capital of Scotland. Lothian Region was created in 1975.

People and government

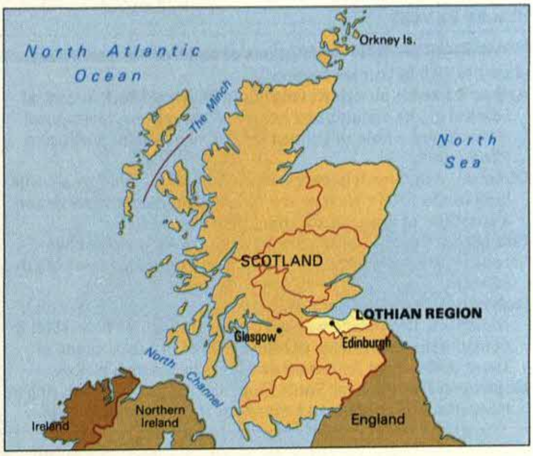
Local customs. Few local customs survive. *Gala days* are popular, especially in the mining villages. A gala queen is crowned and a variety of amusements provided for children. In *burghs* (towns), the gala takes the form of a *common riding.* Young people ride round the traditional burgh boundary.

Recreation. Edinburgh has a fine sports centre and stadium, at Meadowbank, and an Olympic-standard swimming pool. These facilities were constructed for the Commonwealth Games in 1970. On the outskirts of Edinburgh is the longest artificial ski slope in the United Kingdom. Edinburgh has three professional soccer teams that play in the Scottish Football League. They are Heart of Midlothian, Hibernian, and Meadowbank Thistle.

Local government. The region was divided into four districts for administration: *East Lothian, Edinburgh City, Midlothian,* and *West Lothian.* These districts have boundaries similar to those of the counties that existed in the area before Lothian Region was formed. In April 1996, it was replaced by *East Lothian Council, City of Edinburgh Council, Midlothian Council,* and *West Lothian Council.* The Court of Session, which tries the most serious civil and criminal cases, is in Edinburgh.

Facts in brief about Lothian Region

Largest towns: Edinburgh, Livingston, Musselburgh, Bathgate, Whitburn, Penicuik, Dalkeith.
Area: 1,755 km²
Population: *1991 census*—723,678.
Chief products: *Agriculture*—barley, cattle, potatoes, sheep, wheat. *Manufacturing and processing*—distilling, electronics goods, engineering goods, fertilizers, flour, paper, printing. *Mining and quarrying*—coal, limestone. *Fishing*—cod, haddock.



Lothian Region had a long northern coastline. The region is bordered by the Firth of Forth and by the North Sea.

Economy

Edinburgh dominates the economic life of the area, providing many jobs in the church, civil service, higher education, law, and medicine. The city is a major centre for banking and finance.

Manufacturing. Traditional industries include the production of boxes and cartons, confectionery, malt, and printed matter. Leith has electrical engineering, and such typical seaport industries as grain milling and manufacture of agricultural chemicals. The new town of Livingston has become a leading centre for electronics and new technology. Edinburgh has the greatest concentration of industry in the region, with a growing reputation for high-quality electronics production. An export terminal for North Sea oil is at Dalmeny, west of Edinburgh.

Agriculture. The region, especially in its eastern areas, has some of Scotland's best soil. Market gardening is important. Potatoes are grown on light soils toward the coast. The East Lothian plain produces barley. Farmers in the Lammermuir Hills mainly keep sheep, while beef and dairy cattle are raised west of Edinburgh. Newbridge, near Kirkliston, is a centre for rearing broiler chickens. Fishing is of little importance.

Mining. Some modern coal mines supply large power stations near the coast. Coal mining was at one time much more important to the region's economy.

Tourism. Edinburgh is second only to London as a British centre of tourism. Its International Festival has a worldwide reputation in the arts. Edinburgh Tattoo, a military musical spectacular, attracts many visitors. Coastal resorts, such as Dunbar, Gulane, and North Berwick, are popular.

Transport. Transport facilities in the region radiate from Edinburgh. British Rail's east coast main line, running from London to Aberdeen, passes through Edinburgh. To the west, the train journey to Glasgow takes only 43 minutes.

The region's most important roads include the M8, the M9, and the A90. The M8 leads from near Edinburgh towards Glasgow. The M9 connects with the M8 near

Places to visit

Following are brief descriptions of some of the interesting places to visit in Lothian Region:

Arthur's Seat is an extinct volcano in Holyrood Park in central Edinburgh. Its summit, at a height of 251 metres, gives good views of the whole of Lothian Region, the Firth of Forth, and Fife Region.

Dirleton, near North Berwick, is a village dominated by a castle built in the 1200's. Nearby are Yellowcraig nature reserve and a coastline of long, sandy, quiet beaches.

Edinburgh Castle houses the Scottish crown jewels. It has some fine apartments to visit and gives splendid views of Edinburgh.

Holyroodhouse, in Edinburgh, is the Queen's official Scottish residence. The palace was started by King James IV in 1500. It contains the apartments of Mary, Queen of Scots, scene of some of the most important moments in Scottish history.

Hopetoun House, near South Queensferry, is a mansion rich in treasures and containing a museum. It was started in 1696.

Linlithgow has the ruins of a royal palace, overlooking the town loch.

North Berwick is a good centre for touring the eastern part of Lothian Region. The town is a seaside resort, with a harbour, good beaches, and many golf courses. Nearby are Bass Rock, where many sea birds nest, and Preston Mill, the oldest working watermill in Scotland.

Princes Street, in Edinburgh, is often described as one of the most beautiful streets in the world. Along it lie the National Gallery of Scotland, the Royal Scottish Academy, the Scott Monument, and Register House, which contains Scotland's national archives.

Royal Mile is an ancient street running from Edinburgh Castle to Holyroodhouse. It includes the Museum of Childhood, John Knox's house, and Huntly House Museum.

South Queensferry lies west of Edinburgh, between the great Forth bridges. The railway bridge was opened in 1890 and the 2-kilometre long road bridge in 1964.

Edinburgh, and leads northwest along the Firth of Forth. The A90 leads northwards from Edinburgh, passing over the huge Forth Road Bridge, completed in 1964.

Air transport to the region has been limited by the small size of Turnhouse airport, to the west of Edinburgh. In the mid-1970's, a new runway was built, to enable the airport to handle the most modern aircraft.

Leith's port handles considerable amounts of cargo, but its passenger services have virtually ceased.

Communications. Two daily newspapers are published in Edinburgh. *The Scotsman* is a national daily, which circulates throughout Scotland. The *Evening News* is read throughout Lothian Region. Many towns publish local weekly newspapers. Radio Forth is a commercial radio station serving southeast Scotland.

Land

Location and size. Lothian Region lies on a narrow plain running to the south of the Firth of Forth. To the west, Lothian Region is bounded by Central Region and Strathclyde Region. To the south, it is bounded by Borders Region. The region's longest east-west distance is about 87 kilometres. No part of the region is more than 29 kilometres from the coast.

Land features. Lothian Region has some hilly areas, including the Pentland Hills, running southwest from Edinburgh, and the Moorfoot and Lammermuir Hills along the region's southeastern boundary. Many of the region's hills were formed by volcanic action. The region's four main rivers are the Almond, the Esk, the Tyne, and the Water of Leith.

Climate. In the winter, Lothian Region is protected by the nearness of the sea from extreme cold. Average winter temperatures are similar to those in London. But in summer, because of its northerly latitude, the region is considerably cooler than London. Average temperatures at Blackford Hill Observatory, in Edinburgh, are 4° C in January, and 15° C in July.

History

The first people in the region arrived about 4000 B.C. The Romans built the Antonine Wall across Scotland, ending in West Lothian. The Angles of Northumbria captured Edinburgh in 638. For more than 300 years, Lo-

Forth Road Bridge connects Lothian Region with Fife Region across the Firth of Forth to the north.

thian Region was part of the Kingdom of Northumbria. In 973, Lothian became part of the kingdom of the Scots, under Kenneth II.

English invaders ravaged the area in 1544 and 1545. Tensions between English and Scots were lessened in 1603, when James VI of Scotland left Edinburgh to become James I of England. In 1745, during the second Jacobite rising, Bonnie Prince Charlie defeated the British army in the Battle of Prestonpans in Lothian Region.

During the 1700's Edinburgh became a leading European cultural centre. Some famous people associated with Edinburgh at that time were two architects, the Adam brothers, the chemist Joseph Black, the poet Robert Burns, and the portrait painter Sir Henry Raeburn.

In 1842, the first steam railway in Edinburgh linked the city with Glasgow. By 1850, lines radiated from Edinburgh in all directions and tourists arrived to see Edinburgh, which was named "the Athens of the North."

Livingston new town was established in 1962. It was planned as a population centre that could accommodate *overspill* population from Glasgow. In the 1970's, the development of North Sea oil and Britain's membership of the European Community focused economic growth on eastern Scotland and particularly in Lothian Region.

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Raeburn, Sir Henry

Lötschberg Tunnel is a railway tunnel that cuts through the Bernese Alps of south-central Switzerland near the Jungfrau (see **Switzerland** [map]). The tunnel, which opened in 1913, is 14.6 kilometres long. It is part of the Swiss Lötschberg Railway, which is 74 kilometres long and connects Spiez and Brigue. Before the railway reaches Kandersteg, the tunnel's northern entrance, it crosses many bridges and viaducts and passes through 38 tunnels. At Göppenstein, the tunnel's southern end, the railway descends into the Rhône Valley, where it connects with the Simplon Tunnel leading into northern Italy.

Lottery is a popular form of gambling in which drawings are held for cash prizes. In most lotteries, people buy numbered tickets from authorized sellers or from vending machines. Winning numbers are determined at random in public drawings. Many countries run national lotteries as a means of raising revenue. For example, in the United States, about 30 states and Washington, D.C., operate lotteries to supplement tax receipts. Additional states are expected to conduct lotteries as voters approve legislation to authorize state-run lotteries. Sales of lottery tickets raise billions of dollars each year.

Each state offers various forms of lottery play. For example, depending on the game, players must match 3, 4, or more numbers to win. People may choose their own numbers or have a computer select numbers for them. Drawings may be held daily or one or more times a week. In "instant" lottery games, people buy "rub-off" tickets that may reveal immediate winners. In some state lottery games, players may win cash awards of millions of dollars. Winners of lottery prizes of 1 million U.S. dollars or more usually receive payments over a period of several years. Lesser amounts are paid in one lump sum.

The Bible contains many references to the use of "lots" to settle disputes and divide property. Lotteries had become popular throughout Europe by the 1700's, and in the United States by the early 1800's. During the 1830's, many people began to oppose lotteries. State after state prohibited them, and legal lotteries were no longer held in the United States by 1894. But in 1964, New Hampshire revived lotteries when the first of the state-operated games was played.

See also **Gambling.**

The Egyptian lotus, often called a water lily, grows on the surface of rivers and streams. In some ancient cultures, the lotus was a sacred flower.

Lotus is the common name for many different kinds of plants. The lotus known in most places is the Egyptian water lily.

The Egyptian water lily is a familiar sight along the Nile River and neighbouring streams. This plant has white or rose-purple flowers that may be 30 centimetres across. They grow on a weak stalk, 1.2 to 2.4 metres long, and rise only a little above the water. The leaves spread out on the water's surface.

The lotus was a sacred flower to the people of Egypt, India, and China. It is also the national flower of India. A species of the lotus appears in ancient Egyptian art.

The American lotus is a close relative of the East Indian lotus. It also is known as the *water chinquapin* and *yellow water lily.* Its yellow flowers and leaves are on stout stalks that stand 60 to 90 centimetres above the water.

The scientific name *Lotus* has nothing to do with the common name *lotus.* It is a genus of the pea family and consists of about 100 species. The flowers are white, yellow, red, or purple, and have a shape and size resembling pea flowers.

Scientific classification. The Egyptian and East Indian lotuses are in the water lily family, Nymphaeaceae. The Egyptian lotus is *Nymphaea lotus.* The East Indian lotus is *Nelumbo nucifera.* The genus *Lotus* is classified in the pea family, Leguminosae (Fabaceae).

See also **Flower** (picture: Flowers of the tropics and subtropics; table: National flowers); **Trefoil.**

Lotus-eaters made up a race of people who were thought to live in North Africa. In ancient Greek mythology, lotus-eaters were called Lotophagi. It was said that their only food was the fruit and blossoms of the lotus, or jujube tree. People who ate of this magical tree forgot their homeland and the ties of friendship and family. The Greek epic poem the *Odyssey* describes an encounter between the lotus-eaters and the Greek hero Odysseus (Ulysses in Latin). Lord Tennyson's poem "The Lotos-Eaters" is based upon this story (see **Odyssey**). Today, people who continually daydream or think of doing impractical projects are sometimes called lotus-eaters.

Lotze, Rudolf Hermann (1817-1881), was a German philosopher. He attempted to reconcile apparent conflicts between science and religion. Lotze influenced many thinkers of the 1800's, notably the American philosopher Josiah Royce.

Lotze supported the mechanical interpretation of nature as the indispensable method of scientific research. This interpretation explains nature in terms of mechanical causes. Lotze denied that any separate nonmechanical principle accounted for organic existence. However, he insisted that this interpretation has limits and that people's moral values force them to think beyond scientific evidence. He formulated a theory in which nature acts according to a purpose and natural things have a spiritual character. Lotze believed the highest spiritual nature is a personal God, in whom all things exist. Lotze stated that God exercises His will through mechanical causes and the laws of nature.

Lotze was born in Bautzen, in what is now eastern Germany. He taught philosophy at the University of Göttingen. Lotze wrote many books, including *Metaphysics* (1841), *Logic* (1843), *Microcosmus* (1856-1864), and *System of Philosophy* (1874-1879).

Lou Gehrig's disease. See **Amyotrophic lateral sclerosis.**

Louangphrabang (pop. 44,244) is a city in Laos. Its name is also spelled *Luang Prabang.* Until 1975, both Louangphrabang and Vientiane were considered capitals of Laos. Louangphrabang was called the *royal capital* because it was the site of the king's palace. In 1975, Communists took control of Laos and abolished the Laotian monarchy. Vientiane then became the country's only capital. See also **Laos** (map; History).

Loud, John. See **Pen** (History).

Loudon, John Claudius (1783-1843), was a British landscape gardener and horticulturist. He became famous for his *Encyclopaedia of Cottage, Farm and Villa Architecture* (1832) and *Arboretum et Fruticetum Britannicum* (*Woods and Thickets of Britain,* 1833-1838). Loudon was born in Strathclyde Region.

Loudspeaker. See **Intercom; Speaker.**

Lough Derg is the name of two famous lakes in the Republic of Ireland. Lough Derg in Donegal is famous for the Lough Derg Pilgrimage. St. Patrick is supposed to have spent 40 days in prayer and fasting on a small island in the lake. Today, thousands of people visit the island to fast and pray.

The other Lough Derg is the largest lake on the River Shannon. It measures about 40 kilometres in length and from 3 to 5 kilometres in width. The lake lies between the provinces of Connacht and Munster.

Lough Neagh, in Northern Ireland, is the largest lake in the United Kingdom. It is about 29 kilometres long and about 18 kilometres wide. It has an area of about 390 square kilometres. Its depth is mostly between 12 and 15 metres. The counties of Antrim, Armagh, Londonderry, and Tyrone border the lake. For location, see **British Isles** (maps). The River Bann drains the lake (see **Bann**). Lough Neagh has only a few small islands. Much of the land near the shores of Lough Neagh is flat and marshy.

Louis is the name of many famous French kings. The name means *famous warrior,* a characteristic most of the early kings of France possessed. Their efforts to build up an absolute monarchy reached a climax under Louis XIV. Later reigns were marked by a growing dissatisfaction among the common people.

Louis I (778-840), called "the Pious," was king of the Franks and emperor of the Romans. In 814, he succeeded his father Charlemagne. In 817, he arranged for the succession to the throne after his death by dividing the empire among his three sons. After his first wife died, Louis married again, and a fourth son, Charles, was born in 823. Louis redivided his empire in 829 in order to give Charles a share. The older sons resented the new division and revolted. Louis was removed from the throne in 833, but was restored the next year. The bitter struggle between his sons continued until Louis died in 840.

Between that time and the accession of Louis IX in 1226, the seven kings of France who bore this name generally ruled only a few years, often in hectic circumstances. Exceptions were Louis VI, the Fat, who held the throne from 1108 to 1137 and Louis VII, who reigned from 1137 to 1180.

Louis IX (1214-1270), or Saint Louis, the leader of two crusades, was the son of Louis VIII and Blanche of Castile (1187?-1252). He came to the throne when he was 12, with his mother as regent. Under her training, he became a pious, unselfish ruler. He fought a war with Henry III of England, who at that time ruled part of France. This war ended in 1259 when the two kings signed the Treaty of Paris. Louis increased royal power at the expense of the nobles, but he won their respect by being fair and just.

In 1248, Louis led a crusade to the Holy Land. He was defeated in Egypt and taken prisoner. The Muslims released him after he agreed to pay a large ransom. Louis led another crusade in 1270, but died in northern Africa when a plague broke out in his army. He was considered an ideal ruler. Even his enemies admired him for his fairness. Louis was *canonized* (made a saint) by Pope Boniface VIII in 1297. See **Crusades.**

Louis XI (1423-1483), the son of Charles VII, was known as the *terrible king.* While he was still *dauphin* (crown prince), he plotted against his father. Once he was exiled, and once he had to flee for his life. When he came to the throne in 1461, he set out to break the power of the nobles, who were almost independent of royal control. Charles the Bold, Duke of Burgundy, led the nobles. After the duke was killed in battle in 1477, Louis seized most of his territory. Later, the king added Provence, Maine, and Anjou to the royal domain.

Louis used cruel methods to keep his power. He made and broke laws and levied taxes at will. But he strengthened the government, encouraged art and learning, promoted industry and agriculture, opened roads and canals, and helped the poor obtain justice.

Louis XII (1462-1515), called "the Father of his People," was the son of Charles, Duke of Orléans. He came to the throne in 1498, succeeding Charles VIII, his distant cousin. He married Charles' widow, Anne of Brittany.

France prospered under Louis XII, even though he carried on many wars. The king invaded Italy because he claimed Milan, but he was driven out in 1512. The next year, Henry VIII of England defeated Louis in the Battle of the Spurs.

Louis XIII (1601-1643) came to the throne in 1610 after the assassination of his father, Henry IV. His mother, Marie de Médicis, acted as regent until 1617. Cardinal Richelieu served as the chief minister and real ruler of France from 1624 until he died in 1642. He destroyed the political power of the Protestant Huguenots, centralized authority in the hands of the king, and made France an absolute monarchy (see **Richelieu, Cardinal**). During this period, France fought in the Thirty Years' War (see **Thirty Years' War**).

Louis XIV (1638-1715), called "the Grand Monarch" or "Louis the Great," was only four years old when he came to the throne. He succeeded his father, Louis XIII. Louis XIV held the throne for 72 years, and his reign was the longest in modern European history. He was an outstanding example of the absolute monarch. He is said to have boasted, *"L'état c'est moi"* ("I am the State"). These words express the spirit of a reign in which the king held all political authority (see **Divine right of kings**). Louis chose the sun as his royal emblem, and he was often called *Le roi-soleil* (The Sun King).

Detail of an oil painting on canvas (1701) by Hyacinthe Rigaud; the Louvre, Paris

Louis XIV became king of France in 1643 and reigned for 72 years—longer than any other modern European monarch.

The king's mother, Anne of Austria, acted as regent until 1661. Cardinal Mazarin served as her chief minister. In 1648, the Thirty Years' War came to an end. This war strengthened France and weakened Austria and the Habsburgs. But Mazarin was unpopular in France, and his policies led to several years of civil war in a revolt called the *Fronde* (see **Mazarin, Jules Cardinal**). Twice Mazarin had to flee from Paris, but finally in 1653 he put down the rebellion. The failure of the revolt strengthened the king's authority over the nobles.

When Mazarin died in 1661, Louis declared that he would be his own chief minister. His education had been neglected, but he was shrewd in choosing wise counsellors. The greatest of his ministers was Jean Colbert, who reorganized French finance and promoted economy and industry (see **Colbert, Jean Baptiste**).

Louis encouraged writers and artists, and played a part in the development of French literature. Historians often call the 1600's in France "the Century of Louis XIV."

Louis fought four major wars. His great aim was to make himself supreme in Europe. As a start, he hoped to conquer all the land west of the Rhine River. He gained several important territories, but was always checked by the alliances that other countries formed against him. In the War of the Spanish Succession, England took an important part in defeating him. This war, which ended in 1714, left France exhausted and weakened.

Louis married Marie Thérèse of Spain in 1660. But his mistresses influenced him more than she did. The most important of these was Madame de Maintenon (see **Maintenon, Marquise de**). He secretly married her after Marie Thérèse died in 1683. Madame de Maintenon was probably partly responsible for Louis' harsh treatment of the French Protestants, who were called *Huguenots*. For nearly 100 years, they had enjoyed religious toleration and civil rights under the Edict of Nantes. In 1685, Louis revoked this edict (see **Huguenots; Nantes, Edict of**). The government persecuted the Huguenots savagely in an effort to compel them to change their religion. Perhaps 200,000 Huguenots fled from the country. France suffered when the Huguenots left, because among them were many of the most prosperous and industrious persons in the country.

After 1685, Louis' reign was less glorious than it had been in the early years. After Colbert died, the country was plunged into debt by wars. Louis built a magnificent palace in Versailles. He and his court lived there in luxury, while many of the people lived in poverty. The extravagance of court life added to France's financial problems. Louis made the nobles live at Versailles instead of on their provincial estates. France became a nation of absentee landlords who had no contact with their tenants. This condition was one of the causes of the French Revolution. Yet, under Louis, France ranked above all other nations in art, in literature, in war, and in statesmanship. After Louis died, French political influence in Europe declined. See **Dancing** (The 1600's and 1700's; picture: Magnificent court balls).

Louis XV (1710-1774), the great-grandson of Louis XIV, came to the throne at the age of five. Philippe, Duke of Orléans, a relative of the king, served as regent. Louis was declared of age in 1723. Soon after, the Duke of Orléans died, and the Duke of Bourbon became the chief minister. In 1726, the king's tutor, André Hercule Cardinal de Fleury, became the real ruler. Under his government, financial conditions improved greatly, and France showed signs of economic recovery.

When Fleury died in 1743, the king announced that he would rule without a minister, as Louis XIV had done. But he was weak and pleasure loving. A series of mistresses and court favourites dominated him. For 20 years, Madame de Pompadour dictated policies and appointed ministers (see **Pompadour, Marquise de**). She was followed by Madame du Barry (see **Du Barry, Madame**). The king's favourites and mistresses looted the treasury, and France's financial disorder grew worse.

In 1725, Louis married Maria Leszczyńska, daughter of Stanislas I, the exiled king of Poland. France fought the War of the Polish Succession in a vain attempt to restore Stanislas to his throne. France won Lorraine in this war, but gained nothing in the War of the Austrian Succession (see **Succession wars**). In the Seven Years' War, which ended in 1763, France lost its colonies in Canada and India to Great Britain. In North America, this conflict was called the French and Indian War (see **Seven Years' War**). The French people hated Louis for his expensive and disastrous wars and for the scandals of his personal life. His reign did much to bring on the French Revolution. Louis could see the coming disaster, but cared little. He is best remembered for his cynical remark, "After me, the deluge!"

Louis XVI (1754-1793), the grandson of Louis XV, came to the throne in 1774. He was a man of personal virtue and good intentions, but was a weak ruler. He was more interested in hunting than in public affairs. In 1770, he married the beautiful Marie Antoinette of Austria. Louis often relied on the advice of his wife. But Marie Antoinette was unpopular because of her frivolity and her extravagance.

Louis XV

The young king made Robert Turgot minister of finance, and promised to support him in dealing with the public debt. Turgot met opposition when he tried to abolish some of the privileges of the nobles and higher clergy, and Louis dismissed him in 1776. The king then turned to Jacques Necker and promised to support him. The new minister also ran into opposition when he tried to make reforms, and was forced to resign in 1781. By this time, the king had lost the sympathy of his people. During this period, France helped the United States gain its independence in the American Revolution against Great Britain. The war with Great Britain increased France's national debt.

Louis was forced to recall Necker in 1788. Necker asked the king to call the Estates-General, or national assembly, which had not met since 1614. The meeting of the Estates-General in 1789 marked the beginning of the French Revolution. Louis pretended to sympathize with the Revolution. But actually, influenced by the advice of his wife, he opposed it. He and his family were forced to move from Versailles and live under guard in the Tuileries palace in Paris (see **Tuileries**).

Detail of an oil painting on canvas (about 1780) by Antoine-François Callet; Chateau Versailles, France

Louis XVI ruled France when the French Revolution began, in 1789. He was executed for treason in 1793.

In 1791, Louis and his family tried to flee from France, but were arrested. People began to demand that Louis be dethroned. Rioters invaded the Tuileries in August, 1792, and murdered the Swiss Guard. The National Convention deposed the king and declared France a republic. Louis was tried for treason. He defended himself with dignity, but was found guilty. Louis was guillotined on Jan. 21, 1793. Later, Marie Antoinette met the same fate. See **French Revolution; Marie Antoinette.**

Louis XVII (1785-1795) was king in name only, for two years after his father, Louis XVI, was guillotined in 1793. The young *dauphin* (prince) was taken from his mother in 1793 and kept in prison. He died on June 8, 1795, from abuse and neglect. He became known as "the lost dauphin" because there were many stories that he was not dead. Some of these stories said that the young Louis XVII had been rescued and placed in hiding.

Louis XVIII (1755-1824), a brother of Louis XVI, became "the Restoration King" of France after the French Revolution. As the Count of Provence, he fled from France in 1791. He set up a court in Koblenz, in Germany, and issued proclamations against the Revolution. His actions enraged the French people against Louis XVI, and hastened his execution. When Louis XVII died in 1795, the count assumed the title of king. During the period when Napoleon Bonaparte was in power, he lived in several countries in Europe. But Louis XVIII spent the later years of his exile living in England.

In 1814, after Napoleon was defeated, the allied powers allowed Louis to take the throne. He promised to rule as a constitutional monarch. In 1815, during the "Hundred Days" of Napoleon's return, Louis was driven from his throne. But he was restored after the Battle of Waterloo. Louis proclaimed a liberal constitution, and followed moderate policies in his rule. He tried to follow a middle course between the liberals and the reactionaries, who wanted to wipe out all the changes made by the French Revolution.

Louis XVIII

See also **Bourbon; Dauphin; Furniture** (Louis XIV furniture; French styles); **Versailles.**

Louis, Joe (1914-1981), an American boxer, held the world heavyweight boxing championship longer than any other man. He turned professional in 1934, and won the title in June, 1937, by knocking out James Braddock in the eighth round. Louis successfully defended his title 25 times, scoring 20 knockouts. He retired in March, 1949, and later failed in a comeback attempt. Louis combined a steady forward movement with a swift, two-fisted attack. Joe Louis Barrow was born in Lafayette, Alabama, U.S.A., and moved to Detroit as a child.

See also **Boxing** (picture).

Louis Napoleon. See **Napoleon III.**

Louis Philippe (1773-1850) was king of France from 1830 to 1848. He is often called *The Citizen King.* He was born in Paris, the eldest son of Philippe Égalité, Duke of Orléans. He sympathized with the democratic ideas of the French Revolution, and joined the national guard at the beginning of the revolt. He became a lieutenant general and took part in the battles of Valmy, Jemappes, and Neerwinden. But he later joined a plot against the republic and had to leave France.

In 1814, Louis Philippe returned to France and regained his large estates. He was proclaimed "Citizen King" of France after Charles X was forced to give up the throne in the revolution of 1830. A week later Louis Philippe was made king. During his 18-year reign, he was unpopular with all classes of the French people. The *legitimists* opposed him because they were loyal to the descendants of Charles X. The Republicans disliked his autocratic ways. His reign was prosperous but uneventful. "France is bored" became a common saying. The Revolution of 1848 broke out partly because he refused to reform the election laws. He was forced to give up his throne, and escaped to England.

See also **July Revolution; Napoleon III.**

Louise of Mecklenburg-Strelitz (1776-1810) ruled Prussia, with her husband Frederick William III, from 1797 to 1810. Her beauty, generosity, and courage in the face of trouble made her popular with her people. She reigned during the time of Napoleon's attacks on Prussia, and urged her timid husband to resist the French. After the Prussian defeat at the Battle of Jena, she appealed to Napoleon to spare her country, but was unsuccessful. Louise was born in Hanover, Germany. She was the daughter of Duke Charles of Mecklenburg-Strelitz. She married in 1793.

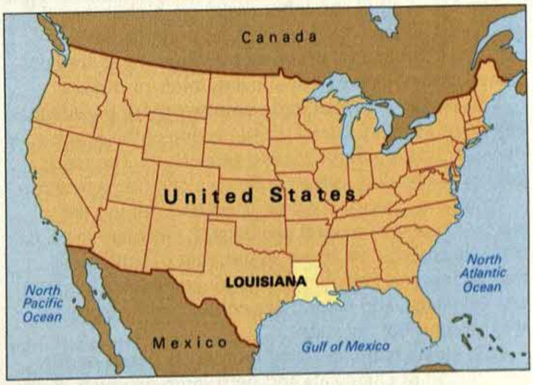
Louisiana is a southern state of the United States. It lies where the Mississippi River empties into the Gulf of Mexico. New Orleans, Louisiana's largest city, ranks among the world's busiest ports. Louisiana's mining industry produces huge amounts of petroleum and natural gas.

The life of Louisiana is based on a mixture of many peoples, cultures, and customs. *Creoles* and *Cajuns* live in southern Louisiana. Creoles are the descendants of the original French and Spanish settlers in the state. Cajuns are the descendants of French settlers from Canada.

Millions of people visit New Orleans each year. It is known especially for its festive carnival season and Mardi Gras celebration (see **Mardi Gras**). The city's charming French Quarter and fine restaurants are major tourist attractions. Visitors also listen to New Orleans-style jazz.

Louisiana's East Gulf Coastal Plain covers the area east of the Mississippi River and north of Lake Pontchartrain. The Mississippi Alluvial Plain lies along the lower Mississippi River.

The West Gulf Coastal Plain includes all of the state west of the Mississippi Alluvial Plain. Marshes stretch



Louisiana is bounded by Texas to the west, Mississippi to the east, and Arkansas to the north.

Facts in brief

Population: 4,238,216

Area: 123,677 km^2

Climate: *Average July temperature*—28° C. *Average January temperature*—10° C.

Elevation: *Highest*—Driskill Mountain, 163 m. *Lowest*—1.5 m below sea level at New Orleans.

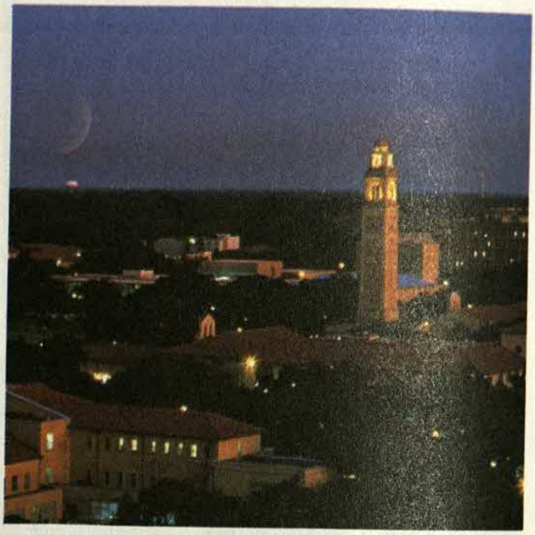
Largest cities: New Orleans, Baton Rouge, Shreveport.

Chief products: *Agriculture*—soybeans, beef cattle, cotton, rice, sugar cane, maize, milk. *Manufacturing*—chemicals, petroleum products, food products, paper products, transportation equipment. *Mining*—petroleum, natural gas.

Origin of name: In honour of King Louis XIV of France.

Nickname: Pelican state (Brown pelicans were once numerous along the coast of the state).

A black jazz band plays a spiritual as it leads a funeral procession to a cemetery in New Orleans. Jazz bands have traditionally played in such processions since the 1800's.



Louisiana State University in Baton Rouge is the state's largest university. Memorial Tower rises above the surrounding buildings on campus. It honours Louisiana's World War I dead.

inland at the southern end of the plain. Large formations called *salt domes* lie beneath the marshes and coastal and offshore waters. Natural gas and petroleum are trapped next to the salt deposits in the domes.

The Mississippi and other rivers are higher than the nearby backlands, so there is great potential for flooding. The chief natural drains of overflow water are Louisiana's many *bayous* (slow-moving inlets or outlets).

Wholesale and retail trade employs more people than any other industry. New Orleans is one of the South's main centres of wholesale and retail trade. The city is Louisiana's leading centre of finance and transportation.

Louisiana ranks second only to Texas among the states in value of mineral production. Petroleum and natural gas account for about 95 per cent of Louisiana's mining income. Petroleum is produced mainly in southern Louisiana, and natural gas comes mainly from the northern part of the state.

Louisiana's manufacturing industry is based on the production of chemicals and petroleum products. Baton Rouge, Lake Charles, New Orleans, and Shreveport are the chief production centres for chemicals.

Beef cattle, cotton, and soybeans are the most important farm products in Louisiana. Louisiana is the leading state in shrimp production.

When Spanish explorers arrived in the Louisiana area during the mid-1500's, about 12,000 Indians lived there. In 1682, the French explorer René-Robert Cavelier, Sieur de la Salle, claimed the entire Mississippi Valley for his country. France sold the area to the United States in 1803 (see **Louisiana Purchase**).

Louisiana became a U.S. state in 1812. It *seceded* (withdrew) from the Union in 1861 and was readmitted in 1868.

Engineers dredged the mouth of the Mississippi River in 1879 so that large ocean ships could reach New Orleans. From 1961 onwards, Louisiana played a major role in the U.S. space programme. In the mid 1980's, a drop in oil prices led to a severe economic decline in Louisiana.

See also **New Orleans**; **Cajuns**; **Creole.**

Louisiana Purchase, in 1803, was the most important event of the American President Thomas Jefferson's first Administration. In this transaction, the United States bought 2,144,476 square kilometres of land from France for about 15 million U.S. dollars. This vast area lay between the Mississippi River and the Rocky Mountains, stretching from the Gulf of Mexico to the Canadian border. The purchase of this land greatly increased the economic resources of the United States, and cemented the union of the Middle West and the East. Eventually all or parts of 15 states were formed out of the region.

Louisville (pop. 269,063) is the largest city in Kentucky and a major industrial centre of the Southeast United States. Louisville serves as an important transportation link between the North and the South. The city lies on the Ohio River along the northern boundary of Kentucky. It grew up beside the falls of the river, and it is sometimes called the *Falls City.* About a fifth of Kentucky's people live in the Louisville metropolitan area.

The Kentucky Derby, one of the world's most famous horse races, is held at Churchill Downs in Louisville on the first Saturday in May. The race draws more than 120,000 spectators each year.

In 1778, a group of pioneers led by the American explorer George Rogers Clark established a settlement on the site of what is now Louisville. The next year, Clark named the town after King Louis XVI of France. He did so in gratitude for France's help to the American Colonies during the American Revolution (1775-1783).

River trade accounted for much of Louisville's early development. Since World War II (1939-1945), its industry has expanded rapidly.

More than 98 per cent of Louisville's people were born in the United States. The city's population includes large groups of people of English, German, and Irish descent. Blacks make up more than a fourth of the population of Louisville. Most of the blacks live in the West End district and in the central city. Slums and unemployment are problems in both of these areas.

About half the people of Louisville are Protestants, of whom Baptists, Methodists, and Presbyterians make up the largest denominations. More than 40 per cent of the people are Roman Catholics.

The Louisville metropolitan area has about 1,100 factories. They produce about 15 billion U.S. dollars worth of goods annually. Louisville is one of the largest tobacco-manufacturing centres in the United States. It is also one of the country's largest producers of gin and whiskey. Other major products of the city include chemicals, electric appliances, paint, plumbing fixtures, and sporting goods. Logging, meat processing, and printing are also important industries. The American Printing House for the Blind, the world's largest publisher of braille products, is located in Louisville.

Louisville's economy has grown since the late 1940's, but the city still faces economic problems. During the early 1980's, the city experienced a decline in manufacturing. But an increase in service industry activities—such as health care, finance, and tourism—took place during the same period.

Reduced employment in Louisville's tobacco industry has also been a problem. A decline in cigarette sales began during the 1960's and forced tobacco companies to lay off many employees. Industrial development led to increased air pollution in the Louisville area. Local governments passed pollution control laws to reduce this problem.

History. In 1778, the explorer George Rogers Clark led a group of pioneers from Pennsylvania down the Ohio River. After a brief stay on an island in the river, the pioneers established a settlement on the shore of the Ohio. The town was named Louisville in 1779. By 1800, about 350 people lived there.

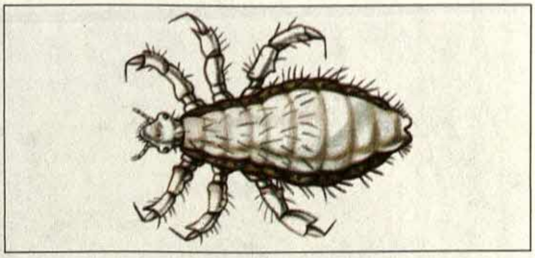
Since the opening of Louisville's first race track in 1830, horse racing has been a leading sport in the city. Many of the horses have been raised in Kentucky's famous bluegrass pastures. The first Kentucky Derby was held in Louisville in 1875.

Lourdes (pop. 17,425) is a town in southwestern France near the Pyrenees foothills (see **France** [political map]). It is famous as a shrine for Roman Catholic pilgrims. It is believed that there, in 1858, the Virgin Mary appeared to a peasant girl, Bernadette Soubirous. A beautiful church, called the Rosary, and a statue of the Virgin stand at the grotto where the vision occurred.

About 2 million pilgrims visit Lourdes each year. Many people go there in search of a miraculous cure for a physical problem. Many bathe in the sacred waters of the grotto spring, in hope that a miracle will restore them to health. Some people leave their crutches as evidence of a cure. The visitors come all year long. Many French Roman Catholics make a pilgrimage to Lourdes for ceremonies on August 20 of each year. The underground Basilica of St. Pius X in Lourdes, opened in 1958, is the second largest Roman Catholic church in Europe. Only St. Peter's Church in Vatican City can accommodate more people.

See also **Bernadette, Saint.**

Lourenço Marques. See Maputo.



A body louse has crablike legs and hooked claws that it uses to cling to its victim. Its body is covered with tiny hairs. The body louse feeds by piercing its victim's skin and drawing blood through a beaklike sucking organ.

Louse is a small, wingless insect that lives on birds and mammals, including human beings. Lice are parasites that feed on the animal on which they live. This animal is called the *host.* Lice cause severe itching and can spread disease.

There are two chief kinds of lice, *chewing lice* and *sucking lice.* Chewing lice, also called *bird lice,* have a mouth designed for chewing. They most commonly are found on birds and feed on the feathers, hair, or skin of the host. Chewing lice are 10 times more abundant than sucking lice and often occur on domestic animals, especially farm fowl. Chewing lice do not attack human beings. Sucking lice have sucking mouth parts. These lice pierce the host's skin and feed on the blood. Each leg of a sucking louse has a claw at the end. The sucking louse uses its claws to attach itself to hairs on the body of the host.

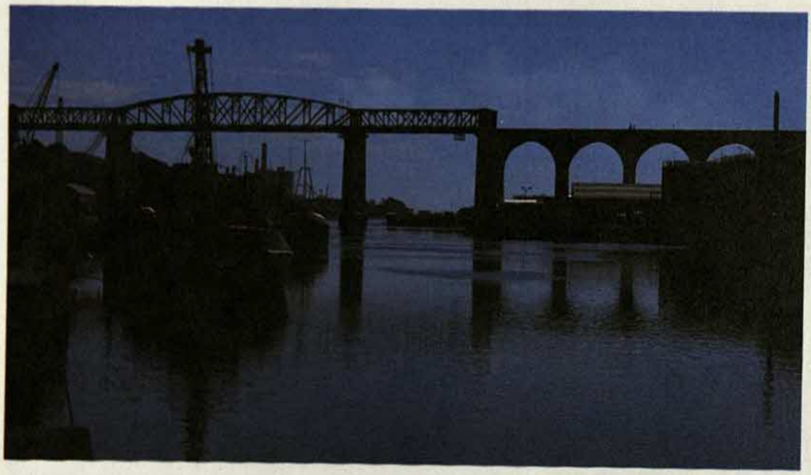
Several species of sucking lice live on human beings. One species, *Pediculus humanus,* is found on human beings exclusively. There are two varieties of this species, the *head louse* and the *body louse.* Head lice live in the hair of the host. They attach their *nits* (eggs) to hairs by means of a gummy substance. Head lice pass from one person to another through the shared use of combs, hats, and other items. Body lice lay their nits in the seams of the host's clothing. Body lice often remain with the clothing or bedding of an infected individual and tend to wander from the clothing of one person to that of another. Body lice can carry and transmit diseases. The most serious of these diseases is epidemic typhus, which can cause death (see **Typhus**).

The best way to discourage sucking lice is to bath regularly and to wear clean clothes. To eliminate lice from the body, doctors may recommend dusting the body with an approved pesticide for lice, or the use of certain lotions or shampoos. Hot-water washing will usually rid clothes of lice.

Scientific classification. Lice are members of the class Insecta. Chewing lice make up the order Mallophaga. Sucking lice belong to the order Anoplura.

Lousewort. See **Figwort family.**

Louth (pop. 90,707) is the smallest county in Ireland. It is on the east coast, in the northeast corner of the province of Leinster and of the Republic of Ireland. It has two large towns, Dundalk and Drogheda. Louth has more people living in towns, and the county is more industrialized than most areas of the Irish Republic.



The River Boyne reaches the Irish Sea near the port of Drogheda, *left,* on the southern boundary of the county of Louth. The railway viaduct across the river carries the main line between Dublin and Belfast.

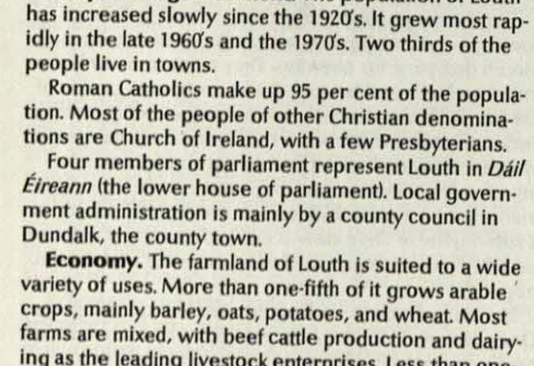
People and government. The population of Louth has increased slowly since the 1920's. It grew most rapidly in the late 1960's and the 1970's. Two thirds of the people live in towns.

Roman Catholics make up 95 per cent of the population. Most of the people of other Christian denominations are Church of Ireland, with a few Presbyterians.

Four members of parliament represent Louth in *Dáil Éireann* (the lower house of parliament). Local government administration is mainly by a county council in Dundalk, the county town.

Economy. The farmland of Louth is suited to a wide variety of uses. More than one-fifth of it grows arable crops, mainly barley, oats, potatoes, and wheat. Most farms are mixed, with beef cattle production and dairying as the leading livestock enterprises. Less than one-tenth of people in Louth work in agriculture.

Three-tenths of people work in manufacturing. Most of the industries are in Dundalk and Drogheda. Dundalk has brewing, clothing, engineering, footwear, meat, and tobacco industries. In Drogheda there are varied food processing, light engineering, and clothing industries.



The county of Louth lies on the border between Armagh, in Northern Ireland, and the Republic of Ireland.

Service industries account for more than half the employment in Louth. Retail and wholesale distribution is the largest sector. A regional technical college in Dundalk serves the northeast of the Irish Republic.

Land. Louth is a border county, with Armagh in Northern Ireland to the north. The Irish Sea is to the east, Meath to the south, and Monaghan to the west.

Much of Louth is lowland, rising to hills in the southwest. The only mountainous area is the picturesque Carlingford Peninsula in the north. Carlingford Mountain is 590 metres high and provides views across the deep fjord of Carlingford Lough to the Mourne Mountains in Down. The River Boyne in the south of the county enters the Irish Sea at Drogheda. Much of the coast is low-lying with some sandy beaches.

The average yearly rainfall is 90 centimetres. Temperatures average 5 °C in January and 15 °C in July.

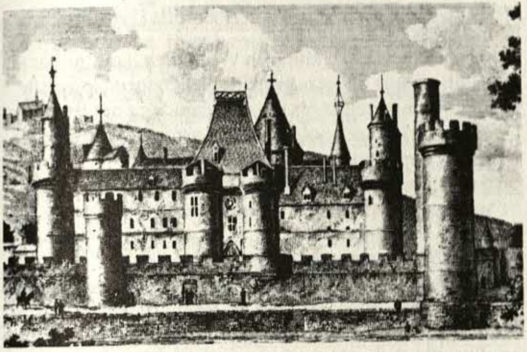
History. Throughout its history, Louth has been strategically important. This is because it lay on the main route between Leinster and Ulster and at the edge of *the Pale* (English dominions in Ireland). Its many castles reflect this feature of its past. The north of the county is associated with the hero of Irish mythology Cuchulainn and the *Táin Bo Cualigne (Cattle Raid of Cooley),* the most famous of Irish epic legends.

Fine sculptured crosses and a round tower mark the site of a Celtic monastery at Monasterboice. Ireland's first Cistercian monastery was at Mellifont. Louth had been part of the Ulster kingdom of Oriel before the Anglo-Normans captured it in the 1100's. Drogheda became an important town and parliament sometimes met there. The English leader Oliver Cromwell stormed it in 1649.

See also **Ireland, History of; Cuchulainn.**

L'Ouverture, Toussaint. See **Toussaint L'Ouverture.**

Louvre is one of the largest and most famous art museums in the world. The Louvre covers more than 16 hectares on the north bank of the Seine River in Paris. The Louvre was built as a residence for the kings of France, but today it exhibits some of the world's greatest art treasures.



Detail of an engraving by Baltard, Bibliothèque Nationale, Paris

The first Louvre was built as a fortress by King Philip II about 1200. It became the royal residence in the 1300's.

The Louvre has about 13 kilometres of galleries and contains more than a million works of art. Many paintings are exhibited in the Grand Gallery, which is more than 400 metres long. The Louvre has especially fine collections of Egyptian, Greek, Oriental, and Roman art. It also has an outstanding collection of paintings and sculptures of the 1800's as well as decorative art.

King Phillip II originally built the Louvre as a fortress in about 1200. King Charles V had the building remodelled into a fortified country house during the early 1300's. The Louvre began to take on its present appearance in the mid-1500's. In 1546, King Francis I decided to transform the building into a palace that would rival the greatest structures of Renaissance Italy. Francis hired the French architect Pierre Lescot to direct construction. Jean Goujon, a French sculptor, decorated the palace and its grounds with statues based on Greek models. Later kings added large courts and long wings to the original building.

The period of expansion ended in 1670 with the completion of the Louvre's east front designed by Claude Perrault. A few years later, the royal court moved to a new palace at Versailles, near Paris. In 1793, during the French Revolution, the revolutionary government opened the Louvre as a public museum to display works from the captured royal collection. Construction on the museum resumed under Napoleon I in the early 1800's, and the Louvre gained its modern form in the mid-1800's with the completion of two wings. A major expansion and modernization project began in 1984 and was opened to the public in 1989.

See also **Europe** (picture: Masterpieces of art).

Louw, Nicolaas Petrus Van Wyk (1906-1970), was an outstanding South African writer and academic. He wrote poetry in the Afrikaans language, and critical works on Afrikaans literature (see **Afrikaans language**).

His first volume of poetry, *Alleenspraak (Soliloquy)*, was published in 1935. It won the Hertzog Prize for literature. This prize was also awarded to his second volume, *Die Halwe Kring (The Half Circle)*, published in 1937, and his last volume *Tristia* (1962). His most influential academic work was *Vernuwing in die Prose* (*Renewal in Prose*—1961).

Louw was born in Sutherland, Cape Province. His academic career began in 1929 with a lectureship in education at the University of Cape Town. In 1950, he was appointed professor of Afrikaans literature and language at the University of Amsterdam in the Netherlands. From 1958 until his death, he was professor of Afrikaans and Nederlands (Dutch) at the University of Witwatersrand in South Africa.

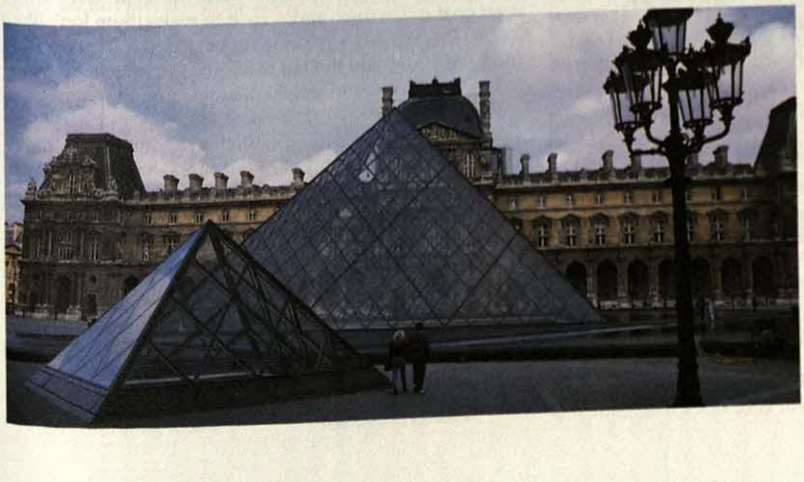
Love. See **Emotion; Sex.**

Love, Nat (1854-1921), was a black American cowboy of the Old West. Love worked in cattle drives for about 20 years, travelling across the Western United States and Mexico. He became known on the open range for his expert horsemanship and ability to identify cattle brands.

Nat Love

Love was born a slave in Davidson County, Tennessee. He left home when he was 15 years old and went to work as a cowboy near Dodge City, Kansas. He worked in cattle drives until 1889. He became a railway porter in 1890.

Love was nicknamed "Deadwood Dick" after he won a riding, roping, and shooting contest in Deadwood, South Dakota, in 1876. His autobiography, *The Life and*



The Louvre is a famous museum in Paris that houses one of the world's great art collections. Visitors enter the building complex through a giant pyramid designed by American architect I. M. Pei and opened in 1989. The rest of the museum took its present form in the 1850's.

Adventures of Nat Love, Better Known in the Cattle Country as Deadwood Dick (1907), has many cowboy stories. It includes tales about such famous Western characters as Bat Masterson, Billy the Kid, Buffalo Bill, and Jesse James. But, like many other legends of the Old West, Love's stories are greatly exaggerated, and his true adventures are difficult to distinguish from the "tall tales."

Love apple. See **Tomato** (History).

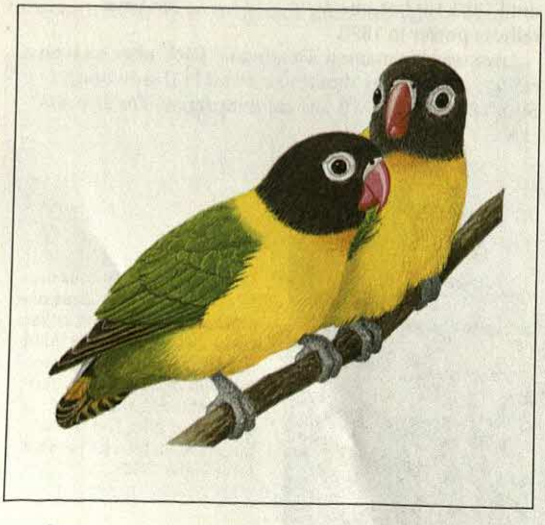
Love-in-the-mist is the name for an attractive flowering plant. It is about 60 centimetres tall. The erect stems have very finely divided foliage. The flowers are blue or white, surrounded by a leafy crown of bracts. The seeds form in a pale brown, inflated seed pod. There are several garden varieties. Love-in-the-mist likes a well-drained soil in a sunny position.

Scientific classification. Love-in-the-mist belongs to the buttercup family, Ranunculaceae. It is *Nigella damascena.*

Lovebird is any one of several kinds of small parrots. They are called *lovebirds* because the mating birds show great affection, caressing each other with their bills and remaining in closely knit pairs. True lovebirds live in Africa. They eat seeds and fruit. Some species have a remarkable way of carrying grass and straw to their nests. They tuck these materials under the feathers at the base of the tail. Then they fly to their nests with the grasses and straws streaming behind. Lovebirds in captivity often tear strips of paper or pick up pieces of string to tuck beneath their feathers. Lovebirds have curved beaks and short tails that are typical of the parrot family.

Scientific classification. Lovebirds belong to the parrot family, Psittacidae. They are members of the genus *Agapornis.*

Lovelace, Richard (1618-1657), was a member of a group of English lyric poets called the *Cavalier* poets. These poets emphasized ideals of love, beauty, and honour. Lovelace is known chiefly for a few famous lines. "Stone walls do not a prison make, / Nor iron bars a cage" comes from the poem "To Althea, from Prison" (1642). "I could not love thee, dear, so much, / Loved I not honour more" appears in the poem "To Lucasta, Going to the Wars" (1648).



Lovebirds are small colourful parrots that live wild in tropical Africa. The birds also are popular pets.

Lovelace was born either in Woolwich, London, or in the Netherlands. He was educated at Oxford University and lived for a time at his wealthy family's country estate. Lovelace served as a soldier in the army of King Charles I. He was imprisoned twice during the civil war that broke out in 1642. He wrote his two famous poems in prison. Lovelace lost his estate while he was serving the king, and he died in poverty.

Lovell, Sir Bernard (1913-   ), an English astronomer, built the world's first completely steerable radio telescope. This telescope can be pointed in any direction. Lovell became famous for tracking the first artificial satellite, the Soviet Union's *Sputnik I,* in October 1957. The telescope has a reflector 76.2 metres wide that focuses radio waves on an antenna in the centre of the reflector. It is called the Jodrell Bank telescope after its site near Manchester, England.

Lovell was born in Gloucestershire and studied physics at Bristol University. During World War II (1939-1945), he worked with radar and became interested in radio astronomy. Radio astronomers study radio waves produced by stars and other celestial objects.

Lovell built the Jodrell Bank telescope because he wanted an instrument that could receive radio waves from most of the visible sky. Queen Elizabeth II knighted Lovell in 1961.

See also **Jodrell Bank Observatory.**

Low, Sir David (1891-1963), a British cartoonist, was famous for his caricatures of British statesmen. One of his best-known characters was Colonel Blimp, a caricature of a certain type of British conservative (see **Blimp, Colonel**). In 1927, Low became chief cartoonist for a London newspaper, the *Evening Standard.* In 1953, he joined the *Manchester Guardian* (now *The Guardian*). Low was born at Dunedin, in New Zealand. He settled in Britain in 1919.

Low Church. See **Anglicans.**

Low Countries are coastal regions located between France and Germany. The Low Countries were once known as *the Netherlands,* but were later divided into Belgium, Luxembourg, and the Netherlands. Each of the Low Countries has a separate article in *World Book.*

Lowchen is a breed of small dog, also known as the *little lion dog.* Its coat is long and wavy, and may be white, black, or pale yellow in colour. Many lowchens have their coat cut in the poodle style to make them look like a lion. The mane is left long, the back and legs are trimmed short, and the tail is tufted. The lowchen stands from 30 to 35 centimetres high at the shoulder, and weighs from 2 to 4 kilograms.

The Lowchen is one of the Bichon group of breeds, which originated in southern Europe. It has been known as a purebred dog since the 1500's. Bred for companionship, it is popular in France.

Lowell, Amy (1874-1925), was an American poet, critic, and biographer. Like a number of other poets of her day, Lowell was strongly influenced by the American poet Ezra Pound. She was particularly influenced by Pound's belief that many poetic conventions of the past were worn out and restricted the poet's creativity. With Pound and other poets, Lowell became a leader of a movement called *imagism.* The imagists emphasized the clear, objective, and precise treatment of images, objects, and events. They wrote in a style known as *free verse* (see **Free verse**).

Lowell experimented with her own version of free verse, beginning with her second volume of poems, *Sword Blades and Poppy Seed* (1914). She called her style *polyphonic,* which means *many-voiced,* because it used all the "voices" of poetry, including assonance, alliteration, metre, and rhythm. Her poems "Patterns" and "Lilacs" were experimental works that came to represent what was considered "modern" in poetry. "Patterns" was published in her collection *Men, Women, and Ghosts* (1916). "Lilacs" was published in *What's O'Clock* (1925), a collection that won the Pulitzer Prize for poetry in 1926, after the author's death.

Lowell wrote several critical works on the poetry of her day. They include *Six French Poets* (1915), *Tendencies in Modern American Poetry* (1917), and *A Critical Fable* (1922). She also wrote *John Keats* (1925), a long biography of the English poet.

Amy Lawrence Lowell was born in Brookline, Massachusetts, into an old and distinguished New England family. She was educated at private schools and travelled widely, carefully preparing herself for a career in the arts. Lowell had a colourful personality and became known for her unconventional life style. Her *Complete Poetical Works* was published in 1955.

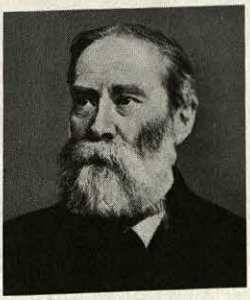
Lowell, Francis Cabot (1775-1817), an American textile manufacturer, founded the first mill that carried through the entire cotton-manufacturing process from raw material to finished cloth. In 1810, Lowell was allowed to inspect the Lancashire cotton mills in England. On his return, he and Paul Moody designed spinning and weaving machinery superior to the best English models. Lowell installed these machines in a mill at Waltham, Massachusetts, which he and others had established in 1814. He also planned good living conditions for his workers. After his death, his associates put this plan into effect in the industrial city of Lowell, Massachusetts, which was named after him.

Lowell was born in Newburyport, Massachusetts. He graduated from Harvard University.

Lowell, James Russell (1819-1891), was an American author who played an important part in the cultural life of the United States during the 1800's. In his own day, Lowell became best known as a poet, but he was also a noted editor, literary critic, lecturer, teacher, scholar, reformer, and diplomat.

Early career. Lowell was born in Cambridge, Massachusetts, and was a member of a noted New England family. Lowell graduated from Harvard University in 1838 as class poet.

Lowell earned a law degree at Harvard in 1840 and practised law briefly before he decided to devote himself entirely to literature.


James R. Lowell

Soon after leaving Harvard, Lowell became active in the abolitionist movement. In 1844, he married Maria White. She also had strong abolitionist convictions and joined him in support of that cause. During the late 1840's, Lowell contributed to several abolitionist publications, including the *National Anti-Slavery Standard,* which he helped edit, and the *Pennsylvania Freeman.*

Literary success. Lowell reached the peak of his literary achievement in 1848. Three of his best-known poetic works—*A Fable for Critics, The Biglow Papers,* and *The Vision of Sir Launfal*—were published then.

The author's sense of humour dominates *A Fable for Critics* and *The Biglow Papers.* His humour and critical insight combine to make *A Fable for Critics* a good-natured verse satire on writers of his day, including Lowell himself. In *The Biglow Papers,* Lowell used humour for social criticism. This work consists of poems and prose notes that show Lowell's opposition to United States involvement in the Mexican War (1846-1848).

Lowell based *The Vision of Sir Launfal* on the legendary search for the Holy Grail, the cup that Jesus used at the Last Supper. The poem has a moral and Christian theme. It represents Lowell's early idealism but it is not an example of his best poetry. The hero is Sir Launfal, a mythical British knight (see **Launfal, Sir**).

Teacher and editor. Tragedy struck Lowell during the years that he became known as a leading poet. Between 1847 and 1852, three of his four children died and his wife, Maria, died in 1853. Although Lowell's outlook remained optimistic, he suffered periods of despondency that continued even after his marriage to Frances Dunlap in 1857. For several years, Lowell's grief over the deaths in his family hampered his ability to write. To earn a stable income, he took teaching and editing jobs. All these developments drew him away from his dedication to poetry.

In 1855, Lowell succeeded the famous poet Henry Wadsworth Longfellow as professor of modern languages at Harvard. He taught there from 1855 to 1872 and again from 1874 to 1876. During most of those years, Lowell also held important editing positions. From 1857 to 1861, he served as the first editor of the *Atlantic Monthly.* From late 1863 to 1872, he was coeditor of the *North American Review.* Under Lowell's leadership, both magazines achieved major literary and intellectual importance.

Lowell continued to write poetry, but his most important literary work after about 1860 was increasingly in prose. His essays on such famous authors as Dante, Shakespeare, and William Wordsworth showed his sharp critical judgment and literary taste. Lowell also wrote outspoken articles on social issues of the day, including the guarantee of full rights of citizenship to blacks.

During the 1860's, Lowell wrote some significant poetry, including a second series of *The Biglow Papers* for the *Atlantic Monthly.* This series reflected his antislavery position and his support of the North during the Civil War (1861-1865). He also wrote two impressive long poems, the *Commemoration Ode* (1865) and *The Cathedral* (1869).

Political activities. After the Civil War, Lowell became increasingly active in politics. He served as a delegate to the Republican National Convention in 1876 but declined an opportunity to run for Congress that year.

Lowell supported the Republican presidential candidate, Rutherford Hayes. After Hayes became President, he appointed Lowell United States minister to Spain. Lowell held this post from 1877 to 1880 and then served as minister to England until 1885. During his years in Spain and England, Lowell became a popular figure in European society and a spokesman for American ideals of democracy.

In 1885, Lowell retired to Elmwood, the family home where he had been born. He lived quietly for the rest of his life but spoke at a number of public events.

Many volumes of Lowell's writings appeared during his lifetime. But with the exception of *A Fable for Critics,* the two series of *The Biglow Papers,* and a few shorter poems, his work has been largely forgotten. In most of his poetry, Lowell failed to achieve excellence. He was, however, a man who followed his conscience on humanitarian and social issues and served his country and the world of learning well in a variety of capacities.

Lowell, Robert (1917-1977), was a leading American poet. Lowell often is considered a "confessional" poet because he used material from his private life to generate an image of modern culture. His poetry dramatizes the pain and tenderness of personal relationships, and his belief that society has been distorted by its overemphasis on worldly things. Lowell received the 1947 Pulitzer Prize for poetry for *Lord Weary's Castle* (1946) and the 1974 Pulitzer Prize for poetry for *The Dolphin* (1973).

Lowell's early poems dealt with the failures and strengths of religious and historical tradition. They were brilliant, complex, and very formal. *The Mills of the Kavanaughs* (1951) gave more personal expression to his themes by using the dramatic monologue. He adopted an offhand and autobiographical style in such works as *Life Studies* (1959), *For the Union Dead* (1964), and *Day by Day* (1977). *Life Studies* won the 1960 National Book Award for poetry. The collection *History* (1973) contains the poet's reflections on world events. Lowell was also an award-winning translator and wrote three plays about early United States history. These plays were published under the title *The Old Glory* (1965). His *Collected Prose* was published in 1987, after his death.

Robert Traill Spence Lowell, Jr., was born in Boston. He was related to the poets James Russell Lowell and Amy Lowell. He was a conscientious objector during World War II and was active in antiwar movements during the 1960's.

See also **American literature** (Personal and confessional poetry; picture).

Lowestoft is a fishing port and seaside resort in Suffolk, on the North Sea coast of England. It lies 16 kilometres south of Great Yarmouth. Lowestoft is part of Waveney local government district. The area has pleasant sands and offers both sea and river fishing. Lowestoft Ness is the most easterly point in England. The town's old part includes the quaint area known as the *Scores.* The town has associations with George Borrow, the writer, and is the birthplace of Benjamin Britten, the composer. See also **Waveney.**

Lowlands. See **Scotland** (The land).

L. S. Lowry was known for his paintings of industrial scenes in Greater Manchester. Many of his pictures show the way of life of the people living in the factory areas.

Lowry, L. S. (1887-1976), a British artist, became famous for his paintings depicting industrial towns in Greater Manchester. His striking use of white and greys gave his work a highly individual style. Laurence Stephen Lowry was born in Manchester. He was elected to the Royal Academy in 1962.

See also **Painting** (picture: *The Pond*).

Lowry, Malcolm (1909-1957), was an English author best known for his novel *Under the Volcano* (1947). In that novel, Lowry created a complex psychological and symbolic study of a disturbed mind. The story takes place on the last day in the life of Geoffrey Firmin, a former British diplomat living in Mexico, who has become a hopeless alcoholic.

Clarence Malcolm Lowry was born in New Brighton, near Birkenhead, England, and graduated from Cambridge University in 1932. Lowry wrote *Ultramarine* (1933), a fictional account of a sea voyage he took as a young man. He did much of his writing from 1939 to 1954 while living in Canada, near Vancouver, British Columbia.

Lowry left considerable unpublished material when he died. Some of it was published after his death, including a book of poems, a collection of letters, and several works of fiction.

Loyalists. See **American Revolution.**

Loyola, Saint Ignatius (1491-1556), was a Roman Catholic religious leader who founded the Society of Jesus. Members of this religious order of men are known as Jesuits.

Ignatius was born into an aristocratic Basque family near Azpeitia, Spain. His real name was Iñigo de Loyola. In 1517, Ignatius became a courtier of the Duke of Nájera. While fighting the French at Pamplona in 1521, Ignatius suffered severe wounds. During his long period of recovery, he read a book about the life of Jesus and stories about the saints. These books convinced him that he should abandon his life of ambition and pleasure. After his recovery, he went to the Benedictine monastery of Montserrat, near Barcelona. There, he hung up his sword at the altar of the Virgin Mary and dedicated himself to a spiritual life.

During much of 1522 and 1523, Ignatius lived in a cave near Manresá, where he prayed and subjected himself to many physical discomforts. During this time, he underwent mystical experiences. Ignatius drew on these mystical experiences in his *Spiritual Exercises,* a manual of self-discipline and prayer. He wrote *Spiritual Exercises* between 1522 and 1541, and it was published in 1548.

To prepare for the priesthood, Ignatius studied humanities and theology in Paris from 1528 to 1535. In 1534, he and six other men formed the Society of Jesus. They took vows of poverty and chastity.

Ignatius was ordained a priest in 1537. He and the other Jesuits then went to Rome to offer their services to the pope. On the way, Ignatius had a vision at the shrine of La Storta, near Rome. In the vision, God told Jesus, "I desire you to take this man for your servant." Then Jesus said to Ignatius, "I will be favourable to you in Rome." Pope Paul III approved the Society of Jesus in 1540. Ignatius became its first *superior general* (head). He also wrote the order's constitutions, which established the Jesuits' organization and way of life.

Under the leadership of Ignatius, the Jesuits helped reform the church during a self-renewal movement called the Counter Reformation (see **Roman Catholic Church** [The Counter Reformation]). The Jesuits also promoted religious education in schools and colleges and preached the Gospel in Asia and the New World. Ignatius regarded himself as divinely chosen to lay the foundation for all these undertakings.

Ignatius remained superior general of the Jesuits until his death. He was *canonized* (declared a saint) by Pope Gregory XV in 1622. His feast day is July 31.

See also **Jesuits; Xavier, Saint Francis.**

LSD is an extremely powerful drug that causes distortions in thinking and feeling. These distortions include *hallucinations,* during which a person sees, hears, smells, or feels things that do not really exist. A dose of only 100- to 200-millionths of a gram of LSD can produce a mental and emotional experience called a *trip* that lasts from 8 to 12 hours. Most scientists believe that people who use LSD do not become physically dependent on the drug.

The letters *LSD* stand for *lysergic acid diethylamide.* LSD is made from *ergot,* a fungus that grows on rye and wheat. Two Swiss chemists, Arthur Stoll and Albert Hofmann, first made LSD in 1938. In 1943, Hofmann accidentally swallowed a small amount of LSD and discovered the drug's hallucinatory effects.

The effects of LSD can seem either pleasant or frightening. The drug may give users the feeling that they are gaining new insights into their personality and past experiences. LSD also makes individuals anxious, confused, or terrified. The user may panic and require medication to overcome the effects of LSD. Some scientists believe the drug can cause birth defects in the babies of women who take LSD during pregnancy.

A person who takes LSD may see shifting patterns of light and "hear" colours. The sensory reactions become exaggerated and moods may alter rapidly from intense happiness to deep depression.

A user of LSD may experience a *flashback* when not under the influence of the drug. During a flashback, a person relives a frightening trip that occurred weeks or months before. The person may also become anxious or depressed and fear losing his or her mind. The number of deaths caused directly by LSD are unknown. However, accidents and suicides have occurred as the result of "bad trips." The possession or sale of LSD is illegal in most countries.

See also **Hallucinogenic drug.**

Lu Xun (1881-1936) was the most important Chinese author of the early 1900's. His satiric short stories of social criticism helped establish the short story as a literary form in China.

He was born in Shaoxing, Zhejiang Province. His original name was Zhou Shuren. From 1898 to 1902, he studied in Nanjing. He then went to Japan where he originally studied to become a doctor. In 1906, he gave up his medical course to study literature. In 1909, he returned to China, where he taught in several universities.

In 1918, his story *A Madman's Diary,* was published. This work, which attacked the Chinese culture of the time, earned him a high reputation. Lu Xun's next story *The Story of Ah Q* was published in 1921. This work attracted great attention in China and other countries.

Luanda (pop. 1,200,000) is the capital and largest city of Angola, and the country's chief industrial centre and port. It lies on the west coast of Africa, along the Atlantic Ocean (see **Angola** [map]).

Industrial facilities in Luanda include foundries; sawmills; textile mills; and cement, printing, and food processing plants. An airport and a railway serve the city.

The Portuguese established a colony in Angola in 1575 and founded Luanda in 1576. The city became the main centre of Portuguese settlement in Angola. The Portuguese built many impressive European-style structures in Luanda, including a fortress, churches, libraries, business and government buildings, and apartment buildings.

Civil war broke out after Angola became independent, and most of the Portuguese left. Today, most of Luanda's people are black Africans.

Luang Prabang. See **Louangphrabang.**

Luba are an important ethnic group in the African country of Zaire. Approximately 3 million Luba live in Zaire. Most of them live in the grasslands of the central and southeastern parts of the country. The Luba consist of two main groups—the Luba-Kasai and the Luba-Shaba.

Most of the Luba-Kasai live in cities and towns. They are familiar with Western culture, and many hold high posts in government, industry, and trade. Most of the Luba-Shaba live in rural villages and work as farmers.

The Luba speak a language called Tshiluba, which belongs to the Bantu family of African languages. The traditional Luba religion recognizes a supreme being as well as lesser gods and the spirits of ancestors. Luba woodcarvers are world famous for the beautiful masks and statues that they create to honour the memory of their ancestors.

The Luba descended from Bantu-speaking peoples who probably came to central Africa about 2,000 years ago. By 1700, a number of Luba-Shaba groups had united to form the Luba Empire. They developed a powerful army that conquered many neighbouring peoples. The Luba also established a prosperous trade in such goods as copper, iron tools, and salt. The empire collapsed in the late 1800's after it was invaded by African, Arab, and Portuguese slave traders.

During the early 1900's, large numbers of Luba-Kasai began to move from rural to urban areas and to adopt numerous aspects of Western culture. Many others took jobs in copper mines in the southern part of the country. During the early 1960's, the competition for jobs and for political influence led to tensions that resulted in outbreaks of violence in several cities between the Luba-Kasai and other ethnic groups.

Lubbock is the name of a British family whose members won fame in several fields, particularly politics.

John Lubbock (1834-1913), the first Baron Avebury, became Liberal member of Parliament for Maidstone in 1870. He was largely responsible for the passing of many acts, including the Bank Holidays Act, the Ancient Monuments Act, and the Shop Hours Act. He was also an authority on natural history and prehistoric anthropology, and wrote many books on these subjects.

John Lubbock was born in London and educated at Eton College. At the age of 14, he went to work at the banking house of his father, who was an eminent amateur astronomer.

Eric Reginald Lubbock (1928-), the fourth Baron Avebury, carried on the family's liberal tradition. In 1962, he gained a remarkable victory in a by-election at Orpington, now in Greater London, turning a Conservative majority of more than 14,000 into a Liberal majority of more than 7,000. He held the seat until 1970.

He was born in London, and educated at Harrow School and Oxford University. In 1963, he became a vice president of the Liberal Party, and Liberal whip in the House of Commons. He was one of the first peers to renounce his title.

Lübeck (pop. 210,318) is the most important German port serving shipping on the Baltic Sea. The city lies in Germany on the Trave River, which empties into the Baltic (see **Germany** [political map]). Lübeck is a centre of machine manufacturing and shipbuilding.

A natural harbour made Lübeck an important trading point from the time it was founded in 1143. In 1226, the city became a self-governing *imperial free city* (see **Free city**). Lübeck was leader of the *Hanseatic League,* a commercial union of north German cities that grew out of trade associations that had begun to develop in the late 1100's. By 1669, when the last meeting of the league's *diet* (assembly) was held, Lübeck had lost much of its importance. See **Hanseatic League.** Completion of the Elbe-Trave Canal in 1900 reestablished Lübeck as an important port by connecting it to the Elbe River, one of Europe's busiest waterways.

Lubitsch, Ernst (1892-1947), a German-born film director and producer, became famous for his comedies and farces. His films are characterized by clever filming devices and ironic insights into human behaviour, especially the battle between the sexes.

Lubitsch was born in Berlin. He gained fame as the director of *Gypsy Blood* (1918), *Passion* (1919), and other historical spectacles. He arrived in Hollywood in 1923 and surprised everyone by turning to the witty, sophisticated comedy of manners, which became known for "the Lubitsch touch." His major comedies include *Trouble in Paradise* (1932); *Ninotchka* (1939), starring Greta Garbo; his satire on war, *To Be or Not To Be* (1942); and *Heaven can Wait* (1943). Musicals such as *The Love Parade* (1929) and *The Merry Widow* (1934) exemplified his creative use of sound.

Lubrication system. See **Petrol engine** (Lubrication system).

Lucas, George (1944-), is an American film producer, director, and writer. He wrote and directed the science-fiction fantasy *Star Wars* (1977), one of the most popular films in cinema history. The film became an international success because of its creative special effects, appealing characters, and exciting story of good versus evil. Lucas produced two later films in the *Star Wars* series, *The Empire Strikes Back* (1980) and *Return of the Jedi* (1983).

Lucas produced the popular films *Raiders of the Lost Ark* (1981) and *Indiana Jones and the Temple of Doom* (1984), and was an executive producer on *Indiana Jones and the Last Crusade* (1989). All three films were directed by his friend Steven Spielberg. The films reflect the love both men feel for the action-packed adventure films of their youth.

Lucas was born in Modesto, California. He won a national student film competition in 1967 for his short film

Electronic Labyrinth: THX 1138-4EB. He was coauthor and director of a feature-length version of the work, *THX 1138* (1971). Lucas also served as coauthor and director of *American Graffiti* (1973). This film about teenagers in the early 1960's reflects his own high school years. Lucas also produced the fantasy film *Willow* (1988).

Luce, Clare Boothe (1903-1987), became famous for her activities in American politics and government. She was also a noted playwright. Luce served in the U.S. House of Representatives from 1943 to 1947 as a Republican from Connecticut. She served as U.S. ambassador to Italy from 1953 to 1956. Luce became one of the first women to represent the United States in a major diplomatic post. She was appointed ambassador to Brazil in 1959, but resigned after winning Senate approval because several senators questioned her ability.

Luce's plays are noted for their sharp dialogue and sarcastic characterizations. Her most successful play, *The Women* (1936), satirizes rich, idle American women. Luce's other plays include *Abide with Me* (1935), *Kiss the Boys Good-bye* (1938), and *Margin for Error* (1939).

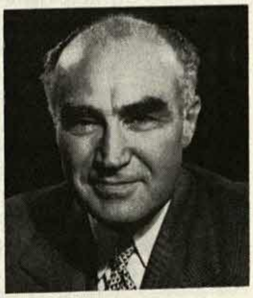
Clare Boothe Luce

Clare Boothe was born in New York City. She worked as a magazine editor and journalist from 1929 to 1934. In 1935, she married Henry Luce, the founder of *Time* and *Life* magazines. After converting to Roman Catholicism in 1946, she wrote several articles on religious subjects.

Luce, Henry Robinson (1898-1967), was a noted American publisher and editor. *Time,* his weekly news magazine, added new words and introduced writing twists to the American language. *Life,* a pictorial magazine begun by Luce, had many imitators.

Luce and his friend Briton Hadden founded *Time* magazine in 1923, and in 1930 Luce started *Fortune,* a periodical for business people. His radio programme *March of Time* began in 1931, and a series of the same name began as newsreels in 1935. Both were abandoned in 1953. Luce purchased *Architectural Forum* in 1932 and began publishing *Life* as a weekly in 1936. He launched another periodical, *House and Home,* in 1952. In 1964, the publishing rights to *Architectural Forum* were given away and *House and Home* was sold. *Life* ceased publication in 1972, but resumed in 1978 as a monthly. The first issue of Luce's magazine *Sports Illustrated* appeared in 1954.

Luce was born in Dengzhou (now Penglai), China. Luce graduated from Yale University. His wife, Clare Boothe Luce, gained fame as a playwright (see **Luce, Clare Boothe**).



Henry R. Luce

Lucerne (pop. 60,562; met. area pop. 158,895) is a tourist centre and historic city in central Switzerland. The German name of the city is *Luzern.* Lucerne lies on the western shore of the Lake of Lucerne and on the banks of the Reuss River. For location, see **Switzerland** (map).

Lucerne is the capital of the *canton* (state) of Lucerne. The city's location along the lake and near magnificent mountains attracts thousands of visitors annually. Its other attractions include medieval houses, the covered Chapel Bridge, an annual music festival, and the Swiss Transport Museum and other museums. The famous *Lion of Lucerne* monument in the city honours Swiss soldiers who were killed while serving the king of France during the French Revolution.

Lucerne dates from the early 700's. In 1332, it became the first town to enter into an alliance with the peasants of central Switzerland. This action was an important step in the eventual unification of Switzerland. See **Switzerland** (History).

Lucerne. See **Alfalfa.**

Lucerne, Lake of. See **Lake of Lucerne.**

Luciani, Albino. See **John Paul I.**

Lucifer is a name commonly used for the devil. It was originally a Latin word meaning *light bearer.* The word comes from a Latin translation of a Hebrew term from Isaiah, which means *shining one.* It appears in Isaiah 14:12: "How you have fallen from the heavens, O shining one, son of morning!"

Isaiah applied the name shining one or Lucifer to a king of Babylon. But it came to be thought of as an evil archangel who was hurled from heaven for his wickedness and revolt against God. The word also refers to the planet Venus as the morning star.

Lucknow (pop. 1,669,136) is a city in north-central India, the capital of the state of Uttar Pradesh. The city stands on the Gomati River, in the fertile Middle Ganges valley. Lucknow is well served with good road, rail, and air links to other parts of the country. For location, see **India** (political map).

The city's minarets and gilded cupolas present a striking picture from a distance. In the northwestern part of the city is the old commercial district with silversmith shops and stalls of other crafts such as fine embroidery, brasswork, and printing. Modern office blocks and shops rise in the southeast of the city. Industries include railway workshops, cotton mills, and sugar factories.

In the 1200's, Muslims built a fort on the site where Lucknow now stands. In 1590, the city became the headquarters of a Mughal province and, in 1775, it was established as the capital of the largely independent Nawabs of Oudh. These rulers built magnificent palaces and mosques along the river in a blend of Mughal and European styles.

The Lucknow region became part of the British Empire in 1856. Indian soldiers seized Lucknow during the Indian Revolt of 1857 (see **Indian Revolt**). The small British force there was trapped for 140 days before being rescued by a British relief expedition in 1858. Lucknow figured prominently in Indian politics during the 1900's. The British focused their efforts on Lucknow in a bid to recruit support from the great landowners and the Muslim League against the Indian National Congress. Since Indian independence was gained in 1947, Lucknow has become a rapidly growing city.

Lucretius (99?-55? B.C.) was a Roman poet and philosopher. His only surviving work is a philosophical and scientific poem called *De rerum natura* (*On the Nature of Things*). Lucretius wrote the poem to free humanity from religious superstition and the fear of death. The poem's emotional power and vivid language help to make it a masterpiece of Latin literature.

Lucretius was inspired by the teachings of the Greek philosopher Epicurus in writing *De rerum natura*. The poem reflects the Epicurean ideals of a tranquil mind and freedom from irrational fear. It argues that people need not fear a life after death, because the soul—like everything else—is a cluster of atoms and therefore disperses after death. The poem also argues that people should not fear the gods, because the gods remain aloof from human affairs. The poem gives rational explanations for earthquakes, thunder, and other phenomena that might be feared as supernatural events.

Lucretius' full name was Titus Lucretius Carus. According to one story, Lucretius went mad after taking a love potion. He wrote poetry during brief periods of sanity, and eventually killed himself. Scholars cannot verify this story, but Lucretius' poem does bitterly denounce the passions of love.

See also **Atomism; Epicurus.**

Luddites attacked textile factories and wrecked machinery in Britain between 1811 and 1816. They were active in Derbyshire, Greater Manchester, Nottinghamshire, and Yorkshire. The Luddites received their name from their mythical leader Ned Ludd. They believed that the introduction of new textile machines in the early 1800's had caused unemployment and lowered the textile workers' standard of living.

In 1811, bands of masked workers attacked factories in Nottingham and destroyed lace and stocking frames. The movement soon spread to other counties. The government replied with repressive measures. A mass trial at York in 1813 sentenced many Luddites to hanging or transportation. Machine breaking flared up again in 1816, during a depression that followed the Napoleonic Wars. The movement disappeared only when improved trade resulted in increased wages and employment for more workers.

Ludendorff, Erich Friedrich Wilhelm (1865-1937), a German general, served as chief of staff to Paul von Hindenburg during World War I. Ludendorff's help in organization and planning resulted, historians believe, in many victories for Germany.

During World War I, Ludendorff rose from the rank of chief quartermaster of the Second Army to chief of staff of the entire German Army. After the collapse of the German Army in 1918, Ludendorff fled to Sweden. He returned in 1919 to enter politics, and aligned himself with the Nazis.

He took part in the unsuccessful *Beer Hall Putsch* (revolution), organized by Adolf Hitler, in Munich in 1923. Ludendorff went to trial along with Hitler, but was freed because of his war record. Later, he broke with Hitler. He became a believer in a pagan religion that worshipped the old German god Wotan. Ludendorff was born near Posen, Germany (now Poznań, Poland). He received a military education.

Luftwaffe has been the name of the German Air Force since 1935. The word means *air weapon* or *air arm*. Reich Marshal Hermann Goering commanded the Luftwaffe during World War II. He succeeded in making it a separate force with a status equal to that of the German army and navy. The Luftwaffe effectively supported German ground forces in Poland, Norway, France, Crete, and the Soviet Union. But it failed to win the critical Battle of Britain. See also **Air force** (Famous air battles); **Goering, Hermann Wilhelm.**

Luge is a winter sport in which one or two people lie on their back on a sledge and race feet first down a steeply banked, ice-covered course. The sledge with the fastest combined time over a number of runs wins the competition. *Luge* is the French word for a small sledge.

A luge sledge has two wooden or plastic runners with steel blades. The sledge is about 1 metre long, 45 centimetres wide, and 20 centimetres high. One-person sledges can weigh up to 22 kilograms. Two-person sledges can weigh up to 25 kilograms. The driver lies on an aerodynamically shaped fibreglass seat. He or she steers by pressing in on the runners with the legs and pressing down on the sledge with the shoulders. Luge sledges have been clocked at over 120 kilometres per hour.

Luge is a winter sport in which one or two competitors race down a steeply banked, ice-covered course on a sledge. Competitors lie on their back and race feet first.

See also **Olympic Games** (table).

Lugworm is a small sea worm with a soft body. Deep-sea fishing enthusiasts often use this worm for bait. Lugworms live along the Atlantic coasts of Europe and North America and around the Mediterranean Sea. They live underwater, in burrows dug into the sand. During low tide, the burrows may be exposed. The lugworm's body is from 13 to 20 centimetres long, and is made up of rings or segments. The front end of the body is thicker than the hind end and is covered with bristles. The lugworm breathes with 13 pairs of gills.

Scientific classification. Lugworms are in the phylum Annelida, class Polychaeta. A common northern species is *Arenicola marina*.

Luke, Saint, was an early Christian who was a friend of Saint Paul. Little is known about Luke. He is mentioned only three times in the New Testament. Paul described Luke as a "beloved physician" (Col. 4:14).

Tradition identifies Luke as the author of the third Gospel and its companion volume, the Acts of the Apostles. Luke's life and career have been reconstructed using this material. Later tradition reports that he taught in Alexandria, Rome, and Greece, and died in Asia Minor. Although modern scholars agree that the same person wrote the third Gospel and Acts, most of these scholars do not consider Luke the author. Luke's feast day is celebrated on October 18.

See also **Gospels; Bible** (Books of the New Testament).

Lully, Jean Baptiste (1632-1687), an Italian-born composer, wrote the first significant French operas. Lully's emphasis on a sense of motion in his music, whether slow or lively, was typical of the baroque style (see **Baroque**). He established a slow-fast-slow tempo sequence for the musical form called *French overture.* He thus set up a contrast with the fast-slow-fast pattern of the *Italian overture.* The melodies of Lully's *arias* (solos) are filled with emotion.

Lully was born in Florence and was brought to France as a child. He became a clever and unscrupulous courtier in the court of Louis XIV. In his operas, Lully adapted ancient myths to heighten the glory of the king, who became his patron. Lully's best-known operas include *Cadmus and Hermione* (1673), *Amadis de Gaule* (1684), *Roland* (1685), and *Armide et Renaud* (1686). He also composed music for many ballets. Lully influenced the works of Jean Philippe Rameau in France and Johann Sebastian Bach and George Frideric Handel in Germany.

Lumen. See **Candela; Light** (Measuring light).

Lumière brothers were two French brothers who became noted scientists. Auguste (1862-1954) and Louis Jean (1864-1948) became known for their work in photochemistry. In 1895, they invented the *Cinématographe,* a combination film camera, printer, and projector. Some of the first films were produced and shown to audiences with this apparatus. In 1904, the Lumière brothers patented the *autochrome plate,* the first popular direct-colour photographic process. The Lumière brothers were born in Besançon, France.

Luminescence is the giving off of light by means other than heat. The emission of light by means of heat is known as *incandescence.* Luminescence usually involves visible light. But it can also refer to infrared and other forms of light the eye cannot see.

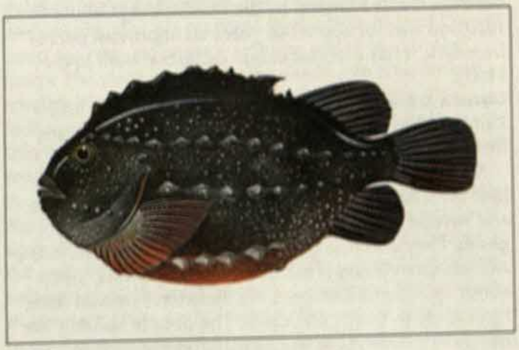
For a substance to become luminescent, the electrons in its atoms must absorb energy. The electrons get rid of this excess energy by giving off light. The energy to produce luminescence can come from various sources, including electric current, X rays, ultraviolet rays, and certain chemical reactions.

Light given off by fireflies and other living things is called *bioluminescence.* Luminescence that stops as soon as the energy source is removed is called *fluorescence.* Luminescence that lasts for seconds or even days after the energy source is removed is called *phosphorescence.*

See also **Bioluminescence; Fluorescence; Phosphorescence.**

Lumpfish, also called *lumpsucker,* is a fish that lives near the shore in the cold ocean waters of the north. Its body and head are thick and short. Its back is arched. The lumpfish has a sucking disc that enables it to cling to rocks. It has wartlike *tubercles* (lumps) instead of scales. Lumpfishes are exploited for food in northern Europe and the Soviet Union. In Great Britain, they are also known as *cockpaddles.*

Scientific classification. The lumpfish is in the lumpsucker family, Cyclopteridae. The North Atlantic lumpfish is genus *Cyclopterus,* species *C. lumpus.*



The bulky shape of the lumpfish gives it its name.

Lumpy jaw. See **Actinomycosis.**

Lumumba, Patrice. See **Zaire** (History).

Luna was the goddess of the moon in Roman mythology. The word *luna* is the Latin word for *moon.* Luna protected crops and controlled the menstrual cycle of women. She drove across the sky at night in a chariot. To explain moonless nights, the Romans claimed that Luna had fallen in love with a mortal shepherd named Endymion and had left the sky to visit him. See also **Monday; Selene; Endymion.**

Luna. See **Space travel** (Space probes).

Luna, Juan (1857-1899), was the most important Filipino painter of the 1800's. He was the first artist from his country to become well known outside the Philippines.

Luna painted in the grand manner of the French Academy of his time. He painted literary and historical scenes. His work dealt with such themes as maidens symbolizing nations, and Roman lovers in theatrical poses. He was appreciated for his confident and forceful brushwork.

Luna was born in Badoc, Ilocos Norte. He studied at the nautical school in Manila before enrolling at the Academy of Fine Arts. In 1877, he went to Spain and studied at the Royal Academy of Fine Arts, Madrid. He travelled to Rome in 1878 and was influenced by Italian artists. At the National Exposition of Fine Arts in Madrid, Luna won a silver medal in 1881 and a gold medal in 1884. He won the gold medal for his huge canvas *Spolarium,* depicting Roman gladiators.

In 1892, he accused his wife of being unfaithful to him. In a fit of jealousy, he shot his wife and her mother dead at their Paris residence. A French court acquitted him of murder, on the grounds that his act was "in defence of his honour." Luna returned to the Philippines in 1894. He died in Hong Kong.

Lunar day. See **Moon** (The orbit of the moon).

Lunar eclipse. See **Eclipse** (with picture); **Moon** (Eclipses).

Lunar module. See **Space travel** (pictures).

Lunar month. See **Calendar.**

Lunar rover. See **Moon** (picture); **Space travel** (Exploring the moon; picture).

Lund (pop. 81,199) is a city in southern Sweden, 20 kilometres northwest of Malmö. It is an important educational and cultural centre for the south of Sweden, with museums of art and cultural history and a major university, founded in 1671. Lund is also a centre for light industries. It was founded by the Danish king Canute in 1020 and was for about 600 years an important part of Denmark. It has a Romanesque cathedral built in the 1100's.

Lunda are a people who live in Zaire, Angola, and Zambia. They ruled several central African kingdoms from the 1600's to the 1800's.

Most Lunda live in small rural villages and farm the land for a living. They grow a root crop called cassava and several grains, including maize, millet, and sorghum. They also fish and sell their catch to towns in the rich copper-mining areas of Zaire and Zambia. Since about 1960, large numbers of Lunda have moved from rural areas to towns and cities. The people speak a language that belongs to the Bantu group of African languages (see **Bantu**). Many Lunda are Christians.

During the early 1600's, the Lunda formed a powerful kingdom under a series of rulers called the *mwaant yaar* (king). The Lunda kingdom became one of central Africa's largest empires. It covered large parts of what are now Zaire, Angola, and Zambia. During the 1700's, several groups broke away and established their own kingdoms. One of these kingdoms—Kazembe in northeastern Zambia—became a major centre of commerce in the 1800's. Kazembe carried on long-distance trade with people on the east and west coasts of Africa.

In the 1900's, the Lunda played a major role in African political developments. The Lunda in Zambia helped drive out the British colonial rulers in 1964. The Lunda in Zaire's Katanga Province (now the Shaba Region) participated in a movement to make the province independent. This struggle resulted in a series of armed revolts in the 1960's and 1970's. Also in the 1970's, the Lunda took part in a civil war in Angola between rival groups that wanted to rule the country.

Lundy Island is an island in the Bristol Channel off the north coast of Devon in the United Kingdom. It lies about 39 kilometres due west of Ilfracombe and 19 kilometres north of Hartland Point. It is 4 kilometres long and $1\frac{1}{2}$ kilometres broad. It is a bird observatory controlled by the British Trust for Ornithology. Many puffins breed on Lundy. The remains of Marisco Castle stand on the island. Lundy belongs to the National Trust (see **National Trust**).

Lüneburg (pop. 59,645) is a city in the German state of Lower Saxony, in northern Germany. Its products include coal, chemicals, iron, and salt, and it is a tourist resort and spa. It has numerous fine buildings dating from the 1200's onward, including medieval churches, Renaissance houses, and a palace of the dukes of Brunswick. The city gave its name to the surrounding administrative district, an area of about 15,000 square kilometres between the Elbe River to the north and east and the Weser and Aller rivers to the west and south. The district is largely rural. The largest part of it, known as the *Lüneburger Heide* (Lüneburg Heath) lies south of the city. It has unspoilt forest areas, conifer plantations, and tracts of wild heathland. Part of it is a nature reserve which attracts tourists and walkers. In this area, Field Marshal Montgomery accepted the surrender of the German forces to the Allies on May 4, 1945.

Lung is the chief breathing organ of mammals, birds, reptiles, and most adult amphibians. The main job of the lungs is to exchange gases. As blood flows through the lungs, it picks up oxygen from the air and releases carbon dioxide. The body needs oxygen to burn food for energy, and it produces carbon dioxide as a waste product. This article discusses the human lungs, but the lungs of other animals function in a similar way.

Parts of the lungs. Human beings have two lungs—a left lung and a right lung—which fill up most of the chest cavity. A lung has a spongy texture and may be thought of as an elastic bag filled with millions of tiny air chambers, or sacs. If the walls of the air sacs could be spread out flat, they would cover about half a tennis court. The somewhat bullet-shaped lungs are suspended within the ribcage. They extend from just above the first rib down to the *diaphragm*, a muscular sheet that separates the chest cavity from the abdomen. A thin, tough membrane called the *visceral pleura* covers the outer surface of the lungs. The heart, large blood vessels, and *oesophagus* (the tube connecting the mouth and stomach) lie between the two lungs.

The lungs are designed to receive air, which enters the body through the mouth or nose. The air passes through the *pharynx* (back of the nose and mouth) and the *larynx* (voice box) and enters the *airways*—a system of tubes that leads into the lungs. The largest of these tubes is the *trachea* (windpipe), which divides into two smaller tubes called *bronchi*. Each bronchus enters one lung, about a third of the way from the top to the bottom of the lung. Within the lung, the bronchus divides into smaller and smaller tubes, much as a tree limb divides into branches and twigs. The final "twigs" are tiny tubes called *bronchioles*. The smallest bronchioles, called *terminal bronchioles*, lead to the *respiratory units* of the lung. The respiratory units are made up of many *alveolar sacs*. Each sac contains about 20 tiny air spaces called *alveoli*. The walls of each alveolus contain networks of extremely small blood vessels called *pulmonary capillaries*. It is here that gas exchange takes place.

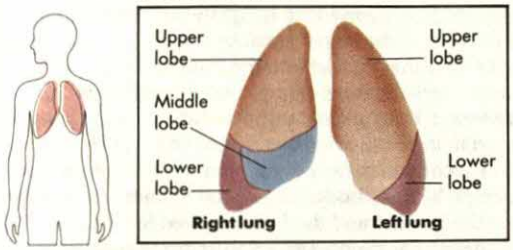
Three to five terminal bronchioles and the alveoli that they supply with air form a *lobule*. Many lobules unite to form the major subdivisions of the lung, called *lobes*. The left lung has two lobes, and the right lung has three. Each lobe has its own branches of bronchi and blood vessels, so a diseased lobe may be removed without sacrificing the usefulness of the other lobes.

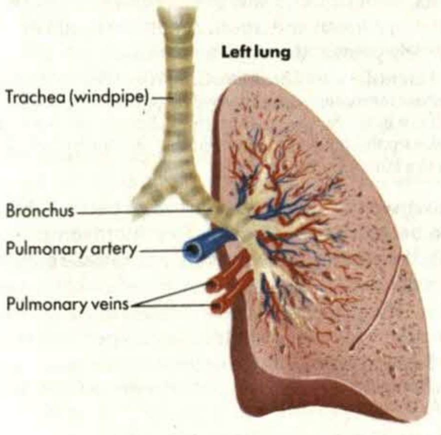
Blood reaches the lung through two routes. Almost all of the blood comes through the *pulmonary circulation*. This blood has already circulated through the body tissues, where it has given up its oxygen and picked up carbon dioxide. A small amount of blood reaches the lungs through the *bronchial circulation*. This blood is rich in the oxygen and nutrients that the airway tissues—like all other body tissues—need.

Parts of a human lung

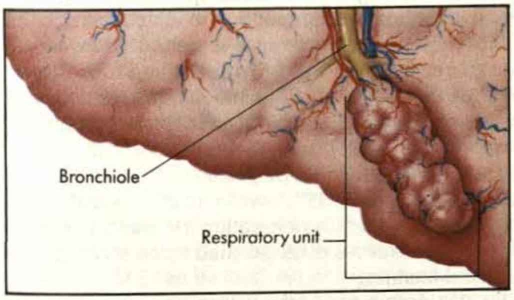
The right lung consists of three lobes, and the left lung, two. Air enters a lung through a *bronchus*, which splits into *bronchioles*. Each bronchiole leads to a *respiratory unit* with *alveolar sacs*.

Lobes of the Lungs

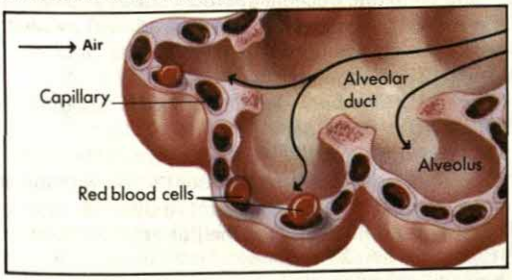




Enlarged Section of a Lung



Cross Section of an Alveolar Sac



An alveolar sac consists of an alveolar duct and about 20 alveoli. Blood picks up oxygen and releases carbon dioxide as it passes through the alveolar walls.

Gas exchange in the lungs. In order to supply oxygen to the blood and remove carbon dioxide from it, the lungs must draw in fresh air and expel stale air. Fresh air is drawn in when the diaphragm and the muscles between the ribs contract. This action—called *inspiration* or *inhalation*—makes the chest volume larger and causes the lungs to expand. The expansion creates a slight vacuum in the lungs, and air from the atmosphere flows in. When the muscles relax, the lungs return to a smaller volume, and gas flows out into the atmosphere. This action is called *expiration* or *exhalation*.

Blood entering the lungs through the pulmonary circulation is dark-coloured, low in oxygen, and high in carbon dioxide. It is pumped by the right side of the heart into the *pulmonary arteries,* which lead to the lungs. The pulmonary arteries divide into smaller and smaller blood vessels, ending with pulmonary capillaries in the walls of the alveoli. The alveolar walls are so thin that oxygen and carbon dioxide move through them easily. Oxygen passes from the alveoli to the blood in the capillaries. At the same time, carbon dioxide leaves the blood and enters the alveoli. Once this exchange is completed, the blood becomes bright red and enters the *pulmonary venous system*. In this system, small vessels join to form larger vessels. The largest vessels, the *pulmonary veins,* carry blood to the left side of the heart. The oxygen-rich blood is then pumped by the left side of the heart back to the body tissues.

Other jobs of the lungs. Because the lungs must inhale the air from the environment, they are exposed to bacteria, viruses, dust, and pollutants. A sticky fluid called *mucus* lines the airways and traps most of these foreign substances. Tiny, hairlike structures called *cilia* move together in a wavelike manner that pushes the mucus upwards into the throat. There, the mucus and its trapped "invaders" are coughed up or harmlessly swallowed. Some substances do not get caught in the mucus and thus make their way into the alveoli. There, special cells called *alveolar macrophages* engulf the particles and carry them to the mucus or destroy them.

The lungs also help cleanse the blood of harmful substances. Blood flowing through the capillaries of the lung is filtered so that particles such as blood clots and fat globules are removed. Macrophages and other cells then break up and remove the trapped material.

Another function of the lungs can be compared to the operations of a chemical processing plant. Some cells make a fatty substance called *surfactant,* which coats the alveoli and allows them to expand easily. Other cells add, remove, or change materials in the blood that affect the function of the lungs or other organs.

Finally, the air exhaled by the lungs is used to make the vocal cords in the larynx vibrate. This action creates the sound necessary for speech.

Diseases of the lungs occur despite the defences provided by the mucus and macrophages. Sometimes, the number of harmful particles reaching the alveoli is so great that the macrophages cannot remove them all. In other cases, the particles can resist or destroy the macrophages.

Because lung diseases can result from many different causes, they are usually grouped by how they affect lung functions. *Obstructive lung diseases,* such as emphysema, asthma, and chronic bronchitis, cause the airways to become partly blocked or narrower, making it more difficult for air to move through them. Cigarette smoking and air pollution are major causes of these diseases. *Restrictive lung diseases* make it harder for the respiratory system to expand. They can cause a stiffening of the lung or chest wall or make the respiratory muscles unable to respond to nerve signals. Breathing in substances such as asbestos, silica, and coal dust can cause some types of restrictive disease. *Pulmonary vascular diseases* affect the circulation of blood in the lungs. For example, in pulmonary hypertension, the small blood vessels of the lung become narrower, making it difficult for the right side of the heart to pump blood.

Some diseases are difficult to categorize because they can harm the lungs in a number of ways. Some pollutants—particularly cigarette smoke—affect the cilia, causing the upward movement of mucus to slow or stop. Smoking cigarettes is also a major cause of lung cancer. Infectious lung diseases, such as tuberculosis and pneumonia, are caused by bacteria, viruses, or other organisms. These diseases are major killers in developing countries.

Related articles. See the Trans-Vision three-dimensional picture with **Human body.** See also:

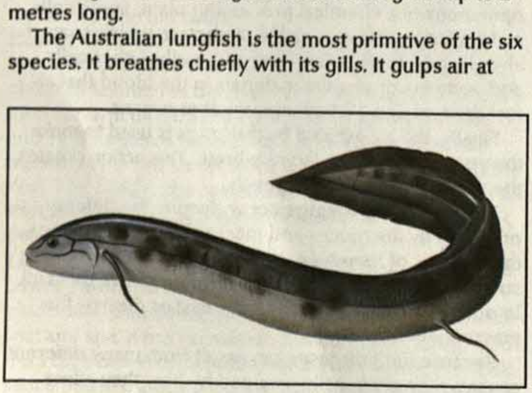
Asthma
Black lung
Bronchitis
Brown lung
Cancer (diagram: How lung cancer develops)
Chest
Diaphragm
Drowning
Emphysema
Histoplasmosis
Human body (picture: Carbon dioxide)
Hyaline membrane disease
Iron lung
Larynx
Legionnaires' disease
Nose
Pharynx
Pleura
Pleurisy
Pneumonia
Pneumothorax
Respiration
Sarcoidosis
Tuberculosis
Windpipe

Lung cancer. See Cancer; Lung (Diseases).

Lungfish is a type of fish that can breathe out of water. It breathes air by means of a lunglike organ called a *swim bladder* or *gas bladder.* The lungfish is one of the oldest known kinds of fish. Scientists have found fossils of lungfish that date from about 400 million years ago. Many scientists regard lungfish as living fossils. They believe that land-dwelling *vertebrates* (animals with a backbone) developed from the lungfish.

There are six species of lungfish. They live in freshwater marshes, swamps, and rivers. Four species are found in Africa, one in Australia, and one in South America. African lungfish are the largest kinds. Some grow up to 2 metres long.

The Australian lungfish is the most primitive of the six species. It breathes chiefly with its gills. It gulps air at the water's surface only when the water contains little oxygen. This lungfish has a long, broad body and two pairs of flipperlike fins.



The South American lungfish has an eel-shaped body with threadlike fins. It gets most of its oxygen by breathing air.

African and South American lungfish are eel-shaped with two pairs of long, threadlike fins. These lungfish have poorly developed gills and breathe almost entirely with their "lung." If held underwater, they will drown. African and South American lungfish can survive hot, dry periods when the water in which they live dries up. At such times, they tunnel into the mud and remain there inactive until the rains return. This behaviour is called *aestivation.* During aestivation, lungfish live off protein stored in their muscle tissues. African lungfish aestivate inside a cocoon made of mud and a slimy substance given off by their body. This cocoon can be easily dug from the ground and the fish removed for food.

Lungfish eat mainly small fish and other water animals, such as frogs and snails. Female lungfish lay eggs. Among African and South American lungfish, the males fiercely protect the eggs and young.

Scientific classification. Lungfish make up the order Dipteriformes in the class of bony fish, Osteichthyes. African lungfish are in the family Protopteridae. South American lungfish make up the family Lepidosirenidae. Australian lungfish make up the family Ceratodontidae.

Lungwort is the name of several perennial plants of the borage family. The common lungwort grows in Eurasia. It has small blue flowers and white-spotted leaves. These leaves were supposed to resemble a diseased lung. The plant was once a popular remedy for lung diseases. It grows in woodland and is pollinated by bees.

Scientific classification. Lungworts are in the borage family, Boraginaceae. The common lungwort is *Pulmonaria officinalis.* Jerusalem cowslip is *Pulmonaria officinalis.*

Lunn, Sir Arnold (1888-1974), was a British pioneer of the sport of skiing. He was a champion skier and invented the *slalom,* a competition in which the skier has to follow an obstacle course. The slalom is now an Olympic event. Lunn was born at Madras, in India. He founded the Alpine Ski Club and Kandahar Ski Club, and was knighted in 1952 for his services to skiing. Lunn wrote more than 50 books, including *The Harrovians* (1913), a book about independent school life.

Lunt, Alfred (1892-1977), was one of the outstanding American actors of his generation. He was a skilled performer noted for his distinguished voice and expressive eyes and manner.

In 1922, Lunt married the British-born actress Lynn Fontanne and thereafter rarely performed without her. Lunt and Fontanne became the most famous acting team in the American theatre. They co-starred in 27 productions, including *The Guardsman* (1924), *The Doctor's Dilemma* (1927), *Design for Living* (1933), *The Taming of the Shrew* (1935), *Idiot's Delight* (1936), *The Seagull* (1938), and *The Visit* (1958).

Lunt was born in Milwaukee, Wisconsin. He made his professional debut in 1912 and later toured with the actresses Lillie Langtry and Margaret Anglin. He achieved his first significant success in the title role in *Clarence* (1919).

See also **Fontanne, Lynn.**

Lupercalia was an important religious festival in ancient Rome. It was celebrated annually on February 15 near the Lupercal, a cave in the Palatine Hill. According to Roman mythology, a wolf in the Lupercal nursed the infant twins Romulus and Remus, the legendary founders of Rome.

The festival included banquets, dancing, and the sacrificing of goats. Whips were made from the hides of the sacrificed goats. Two teams of young men called *Luperci* raced naked around the hill. Women who wanted to have children stood near the path of the runners to be struck by the whips. The Romans believed that a woman struck by a whip would become fertile.

Lupin is the name of a group of plants in the pea family. Lupins have wandlike clusters of showy blue, yellow, white, or red flowers that resemble sweet peas. The leaves have several narrow leaflets, all attached at the same point. Some kinds of lupins contain poisonous alkaloids, but the seeds of others can be eaten.

Scientific classification. The lupins are classified as members of the pea family, Leguminosae (Fabaceae). They make up the genus *Lupinus.*

See also **Bluebonnet; Flower** (pictures: Garden perennials; Flowers of the Arctic tundra).

Lupus is the name of any of a group of diseases that affect the skin. The word generally refers to the disease *lupus erythematosus.* However, it may also refer to *lupus vulgaris,* which is a tuberculosis of the skin of the face. This article discusses lupus erythematosus.

The most serious form of lupus erythematosus is *systemic lupus erythematosus* (SLE), which may attack the internal organs as well as the skin. People with SLE have such symptoms as fever, chest pains, painful and swollen joints, and a butterfly-shaped rash across the nose and cheekbones. They also may suffer sores in the mouth and nose, lose their hair, and be sensitive to sunlight. Most victims are women from 15 to 35 years old. SLE occurs about four times as frequently in blacks as in whites.

The basic cause of SLE is unknown. However, researchers believe the disease involves a breakdown of the body's *immune system.* Normally, this system protects the body from infection by producing substances called *antibodies,* which attack harmful bacteria and viruses. In SLE, the immune system apparently produces antibodies that attack healthy tissue instead.

Mild cases of SLE require no treatment. Doctors treat more severe cases with such drugs as aspirin and cortisone, which reduce inflammation in internal organs. Severe cases of SLE can be fatal, especially if the kidneys are damaged. SLE cannot be cured completely, but most patients under treatment for the disease have no symptoms for long periods of time.

Another form of lupus, *discoid lupus erythematosus* (DLE), affects only the skin. In rare cases, DLE may leave scars or develop into SLE.

Lusaka (pop. 818,994) is the capital and largest city of Zambia. The city lies on a high plateau in south-central Zambia. It is near the midpoint of a railway and at the junction of two main roads. For location, see **Zambia** (map).

Lusaka has many large buildings, including the parliament buildings and the University of Zambia. Most of the city's commercial and government buildings stand along wide, shaded streets. Lusaka is a city of contrasts, with upper-class areas and slums. The city has several scenic parks. The main shopping district is famous for open-air bazaars that sell handmade items.

Lusaka, capital city of Zambia, is the country's major centre for trade and commerce.

Lusaka is a trade centre and a major market for farm products grown in rural areas of Zambia. Its main industries make cement, furniture, shoes, and textiles and process beverages, food, and tobacco. Zambia's government employs many of the city's people.

European settlers established Lusaka about 1905 as a small trading post. It was originally called *Lusaakas.* The city came under British rule in the early 1900's. In 1935, Great Britain made Lusaka the capital of its colony of Northern Rhodesia. The colony became the independent nation of Zambia in 1964.

See also **Zambia** (picture).

Lüshun lies near the tip of the Liaodong Peninsula in northern China (see **China** [political map]). Lüshun is a district in the Lüda municipality. Lüshun was formerly called *Port Arthur.* There are two sections in Lüshun, the old Chinese city and the new town built by the Russians when they took Lüshun in 1898.

The British named the city Port Arthur when they used it as a base to fight China in 1857. Later, the city became a Chinese naval base. Japan took Lüshun from Russia in 1905, after winning the Russo-Japanese War. After World War II ended in 1945, China and the Soviet Union agreed to share the port as a naval base. In 1955, the Soviet Union returned Lüshun to full Chinese control.

Lusitania was a British passenger ship that sank near Ireland after the German submarine *U-20* torpedoed it on May 7, 1915, during World War I. A total of 1,198 people died. Many people considered the sinking an act of barbarism. Afterward, Germany stopped attacking neutral and passenger ships around Britain for nearly two years.

The German government had claimed the *Lusitania* was a legal target because it was armed and carried war materials. An official British inquiry denied that the ship was armed, but confirmed that it had a supply of ammunition. As a result of the sinking, support for Britain increased in the United States. The United States entered the war in 1917, and "Remember the *Lusitania!*" became a common slogan.

Lute is an ancient stringed musical instrument. It has a pear-shaped body, a neck with a *fretted* (ridged) finger board, and a *pegbox* attached to the neck at a sharp

The lute is an ancient stringed instrument. The body and neck resemble those of a large mandolin, but the angle at which the head is set into the neck gives it a distinctive appearance.

angle. The pegs are turned to tune the 11 strings, which run along the neck to a low *bridge* near the bottom of the body. The player plucks the strings with the thumb and fingers of the right hand. The fingers of the left hand press down on the strings along the neck to set the pitch.

Lutetium (chemical symbol, Lu) is one of the rare-earth metals. It has an atomic number of 71 and an atomic weight of 174.967. The name comes from *Lutetia,* the ancient name for Paris. The French scientist Georges Urbain discovered lutetium in 1907. He developed a process for separating the original element ytterbium into two elements, lutetium and ytterbium, or neoytterbium. Lutetium is found with ytterbium in the minerals gadolinite, xenotime, and other minerals that bear rare earths. It is best separated from the other rare earths by ion-exchange or solvent-extraction processes. The metal has a silver colour. It has a melting point of 1663° C and a boiling point of 3402° C. It has a density of 9.84 grams per cubic centimetre at 25° C (see **Density**). It is the heaviest rare-earth element. See also **Element, Chemical; Rare earth; Ytterbium.**

Luther, Martin (1483-1546), was the leader of the Reformation, a religious movement that led to the birth of Protestantism. His influence has reached beyond Protestantism and even beyond Christianity. For example, Luther's translation of the Bible into German is a literary masterpiece. It did more than any other single force to create the modern German language.

Next to the Bible translation, Luther's most influential literary work was his *Small Catechism of 1529.* It became known as the *layman's Bible.* In clear, simple language, the catechism summarized what Christians should believe and how they should live. Millions of people have learned the fundamentals of Christianity from Luther's catechism or from one of its adaptations.

Luther's role in the history of music is almost as significant as his contributions to German literature and the German language. His hymns opened a new era in music. Luther's best-known hymn was "A Mighty Fortress Is Our God."

Detail of an oil portrait on wood (1526) by Lucas Cranach; Nationalmuseum, Stockholm

Martin Luther

Early life. Luther was born in Eisleben in Saxony on Nov. 10, 1483. He entered the University of Erfurt in 1501 and decided to become a lawyer. But in 1505 he entered a monastery, shortly after undergoing an intense religious experience during a thunderstorm.

Luther was ordained a priest in 1507 and taught briefly at the University of Wittenberg in 1508. In 1512, he received a doctor's degree in theology and was appointed a professor of theology at Wittenberg. He held that position for the rest of his life.

Justification by faith. There is no evidence that Luther as a young man considered himself anything but a faithful son of the Roman Catholic Church. Yet he was already puzzling over questions that later led to the Reformation. These questions did not deal with the external structure of the church or its moral values, all of which Luther considered important but not vital. Luther concerned himself with the meaning of the Christian Gospel: How does an individual find favour with God? To Luther, this was not a problem to be settled by discussion of human merit in relation to divine grace. It was an intensely personal problem that affected Luther himself.

For Luther, the life of the church, especially the ordered life of a monastery, provided remedies for those individuals who were troubled by their relation to the judgment of an angry God. Individuals could say more prayers, fast more strictly, and whip themselves more mercilessly. Finally, they would achieve the certain knowledge that God regarded them favourably. Luther tried all these methods, but none of them worked for him. The harder he tried to please God, the more he realized that he was depending not on God, but on his own efforts.

The answer came to Luther in 1508 or 1509 while he was studying the Book of Psalms and the Epistles of Paul. Luther concluded that God's favour is not a prize to be won, but a gift. Only when individuals stop trying to achieve God's favour by their own abilities and accomplishments can they understand the grace of God. God *justifies* individuals—that is, makes them righteous before Him—not through their moral goodness or faithfulness to duty, but because of His kindness. God's kindness, Luther believed, was given to the world in the life, death, and Resurrection of Jesus Christ. This was the meaning of justification solely by faith in God's grace, the doctrine for which Luther became famous.

At first, Luther did not regard justification by faith as anything new. He blamed himself for not having discovered sooner what he felt all the great theologians had known and taught. The doctrine involved Luther in controversy for the rest of his life.

Woodcut (about 1550) from the workshop of Lucas Cranach the Elder; Staatliche Lutherhalle, Wittenberg, Germany

Martin Luther gives Communion to Duke John of Saxony, *left.* The dukes of Saxony were Luther's protectors during the Reformation. The artist also showed the Protestant reformer John Hus giving Communion to Duke Frederick the Wise of Saxony, *right.* But Hus actually had died before Luther was born.

The Ninety-Five Theses. The first controversy in which Luther became involved concerned *indulgences.* The church had developed indulgences as a means of pardoning sinners from part of the penalty for their sins. For example, individuals could be ordered to go on a *pilgrimage* (journey to a sacred place) to make up for their sins and to prove they were sincere about repenting. An indulgence permitted them to contribute a certain amount of money to a worthy cause instead.

The practice of selling indulgences was sometimes abused as a means of raising money. In addition, Luther believed that indulgences degraded the forgiving grace of God and weakened the church itself.

On Oct. 31, 1517, Luther posted his famous Ninety-Five Theses on the door of the Castle church in Wittenberg. The theses included statements challenging indulgences. Luther acted in response to a sale of indulgences near Wittenberg by Johann Tetzel, a Dominican monk. The theses drew Luther into direct conflict with the church as none of his other statements had done, though many of them were more radical. These radical statements dealt with such issues as the authority of the Bible and the doctrine of God's grace.

Reformation leader. In 1518, Luther met the German scholar Philipp Melanchthon, who became his chief associate during the Reformation. In 1519, Luther had a famous debate in Leipzig with Johann Eck, a Roman Catholic theologian. During this debate, Luther denied the supremacy of the pope and declared that church councils could make mistakes.

In 1521, Luther was excommunicated by Pope Leo X. Charles V, emperor of the Holy Roman Empire, then ordered Luther to appear before a *diet* (meeting) of princes, nobles, and clergymen in Worms, Germany, in April of that year. The diet demanded that Luther retract his teachings, but he refused. He declared: "Unless I am convinced by the testimony of the Scriptures or by clear reason (for I do not trust either in the pope or in councils alone, since it is well known that they have often erred and contradicted themselves), I am bound by the Scriptures I have quoted and my conscience is captive to the Word of God. I cannot and I will not retract anything, since it is neither safe nor right to go against conscience. I cannot do otherwise."

For most of his public career, Luther did not belong to any of the various opposing groups of the Reformation. For example, he revised the worship of the church. But the new liturgy he created in the language of the common people was too Protestant for the Catholics and too Catholic for the Protestants. Luther also insisted that individual Christians must do their own believing, just as they must do their own dying. But after some Protestants concluded that infants—who cannot believe for themselves—should not be baptized, Luther vigorously defended the tradition of infant baptism.

During the Reformation, Luther discovered to his surprise and disappointment that he had founded a new church. Luther complained that he did not want to give his name to a community that should take its name only from Christ. But Lutheranism remains the name of the doctrines and beliefs that he originated.

Theological writings. In spite of his active public life, Luther was primarily a university scholar. In 1520, he wrote many works, including two that had far-reaching effects. *The Babylonian Captivity of the Church* attacked church sacraments. *The Freedom of the Christian Man* declared that a Christian was a free person, subject to no one, yet at the same time a willing servant, freely subject to everyone. Luther considered *The Bondage of the Will* (1525) his most significant writing. It attacked the Dutch humanist Desiderius Erasmus and tried to prove that people cannot do anything to contribute to their salvation. They must receive it from God as a gift.

The majority of Luther's writings were discussions about books of the Bible. Most of them were delivered as classroom lectures and then published. The most important of these works, *Lectures on Galatians* (1535), summarized many of Luther's chief ideas.

Luther's place in history. By the time of his death in Eisleben on Feb. 18, 1546, Luther was recognized as a major figure in the history of Christianity and the world. He symbolizes the split within Christianity between Protestants and Roman Catholics. This split has affected the political and cultural development of every nation in Europe and North and South America. Luther also continues to be the source of some of the most powerful ideas in Christian thought. Many of the reforms adopted by the Roman Catholic Church during the 1960's recall points that Luther made more than 400 years earlier. One such point involved using the language of the people, rather than Latin, for worship.

Luther has been called the most influential German who ever lived. Knowledge of his life and work is necessary to understand the history of Scandinavia, England,

and the Americas. Luther has been extravagantly praised and extravagantly condemned. As a result, it is difficult to discover the real Luther behind the myths of his disciples and enemies. Every aspect of Luther's life has been examined by both friends and foes. During the 1900's, the excessively one-sided views have been softened by historical research, and something like general agreement has begun to emerge.

Related articles in *World Book* include:

- Bible (Early English translations)
- Eck, Johann
- German language (Development)
- Indulgence
- Leo X
- Lutherans
- Melanchthon, Philipp
- Peasants' War
- Protestantism
- Reformation
- Tetzel, Johann
- Worms, Edict of

Lutherans make up the largest Protestant church in the world. The Lutheran church was founded in the early 1500's on doctrines and beliefs voiced by the Reformation religious leader Martin Luther. Yet the church claims descent from the authentic Christian tradition in the centuries before the Reformation.

Lutherans do not have any single form of organization that distinguishes them from other Christian groups. Some Lutheran groups have bishops, while some insist on the sovereignty of the local congregation. Other Lutheran groups fall between these two extremes.

Lutherans have no uniform way of worship. Some Lutheran *liturgies* (services) are as formal as the Roman Catholic Mass. Other Lutheran services seem very close to the severe simplicity of Puritan worship.

Doctrine. What sets the Lutherans apart from other Christian churches are the teachings of Luther's Reformation. The best-known statements of Luther's teachings appear in two catechisms he wrote in 1529 and in the Augsburg Confession of 1530. These statements provide the basis for the Lutheran belief that people can be saved only by faith—rather than through their own moral efforts or good works. Instead, people are freed from sin by God through God's gift of grace through Jesus Christ on the cross. Once set free from sin by the grace of God, people become new creatures, able and willing to serve God and their neighbour. Lutherans see this message of God's forgiving love as uniquely set forth in the Bible. They believe the Bible has authority over teaching in the church. They have two sacraments, baptism and the Lord's Supper. The Lord's Supper is also called the Eucharist or Sacrament of the Altar.

Lutheran beliefs and attitudes have also been formed by the social history of the church. Many Lutherans live in the Scandinavian countries, where Lutheranism is the state religion, and in Germany. Lutherans living outside Europe are usually descended from these North Europeans. Many of the qualities associated with North European cultures are closely related to the Lutheran heritage. For example, the strong sense of personal duty identified with a kind of German Lutheranism is a characteristic of Germany as well as of Lutheranism.

Lutherans have tended to be relatively conservative on political and social issues. This attitude can be traced partly to the church's association with North European cultures and with the ruling classes within them. Luther helped set the pattern for this conservatism. He stressed the virtue of obedience and feared anarchy more than injustice. But in some historical instances—for example, Hungary in the 1800's—Lutheranism has been more revolutionary than other Christian churches.

Related articles in *World Book* include:

- Luther, Martin
- Reformation
- Sweden (Religion)

Luthuli, Albert John (1898-1967), won the 1960 Nobel Peace Prize for his peaceful efforts to end racial segregation in South Africa. Luthuli, a former Zulu chief, led the African National Congress until the government banned it in 1960. In 1959, the government prohibited him from making speeches and from leaving his home village of Groutville, near Durban. However, he was allowed to go to Norway for his prize.

Lutine Bell hangs on the rostrum in the Underwriting Room at Lloyd's, in London. It is rung to call the attention of members when an important announcement is to be made. One stroke means that bad news is to follow and two strokes mean good news. Originally, the news was generally of an overdue vessel. The bell comes from HMS *Lutine,* a 32-gun frigate wrecked off the Dutch coast in 1799. It carried a large amount of money and bullion insured at Lloyd's. The bell was later salvaged.

Luton (pop. 167,300) is a manufacturing town and local government district in Bedfordshire, England. It is situated about 48 kilometres north of London. Luton is a well-known centre of car manufacture. Other local industries produce ball bearings, electrical goods, and scientific instruments. A hatmaking trade, started 100 years ago, still thrives in Luton. The town has a large church, St. Mary's, built in the Perpendicular Gothic style. To the east is Luton Airport.

See also **Bedfordshire.**

Luttrell Psalter is a handwritten book of psalms noted for its beautiful illustrations of English country life and customs of the Middle Ages. The *Luttrell Psalter* was written in about 1340 for Sir Geoffrey Luttrell, a landowner and member of Parliament. It is now kept in the British Museum building, in London.

Lutyens, Sir Edwin Landseer (1869-1944), was one of the most important English architects of the early 1900's. His designs show the influence of Palladian Revival and other English architectural styles of the 1700's (see **Architecture** [The Palladian Revival]). Lutyens first

Munstead Wood, near Godalming, in Surrey, England, is one of the first country houses designed by Sir Edwin Lutyens.

became prominent for country houses he designed with the English landscape architect Gertrude Jekyll. Their best-known country houses included Munstead Wood (1896) near Godalming, Surrey, and Deanery Garden (1901) in Sonning, Berkshire. Later in his career, Lutyens turned to town planning. Two of his most important projects were the village centre in Hampstead Garden Suburb, London, and the layout for the city of New Delhi, India. His other works include the Cenotaph war memorial (1920) in London and the British Embassy in Washington, D.C. (1930). Lutyens was born in London.

Lutyens, Elisabeth (1906-1983), pioneered the introduction of Arnold Schoenberg's 12-note method of composition in the United Kingdom. She began to write music in this way in 1939 and became an expressive composer in the idiom. Her music includes orchestral compositions, chamber music, choral works, piano pieces, songs, and music for films and radio. Elisabeth Lutyens was born in London. Her father was Sir Edwin Landseer Lutyens.

Luxembourg is one of Europe's oldest and smallest independent countries. It lies in northwestern Europe where Germany, France, and Belgium meet. It covers only 2,586 square kilometres. For Luxembourg's total population, see the *Facts in brief* table with this article.

Luxembourg has scenic areas of rolling hills and dense forests. The whitewashed houses of the country's small towns and villages cluster around medieval castles and churches. Luxembourg is one of the world's most industrialized countries. Most of its industries are located in the southwest corner of the country.

Luxembourg was established as an independent state in 963. Its official name is Grand-Duché de Luxembourg in French and Grossherzogtum Luxemburg in German (Grand Duchy of Luxembourg). The city of Luxembourg is the country's capital and largest city.

Government. Luxembourg is a constitutional monarchy. The grand duke (or duchess) of the House of Nassau serves as monarch and the country's chief executive. The monarchy is a *hereditary* office. It passes to the oldest son or daughter of the monarch. A 64-member parliament called the Chamber of Deputies makes Luxembourg's laws. The people elect the members to five-year terms. The monarch appoints a prime minister and 10 other Cabinet ministers to carry out the operations of the government. The Cabinet members must have the support of a majority of the members of parliament. The monarch also appoints for life a 21-member advisory body called the Council of State.

Luxembourg is divided into three districts, each headed by a commissioner appointed by the national government. The districts are divided into 12 cantons, and the cantons are divided into communes. Elected officials head the cantons and communes.

People. Luxembourgers have close cultural ties with neighbouring Belgium, France, and Germany. But they maintain an independent spirit, as expressed in words of their national anthem, *"Mir welle bleiwe wat mir sin"* ("We want to remain what we are"). Most Luxembourgers enjoy a high standard of living. They have better food and housing than many other Europeans have. The country has extensive government-sponsored systems of social security and health care benefits.

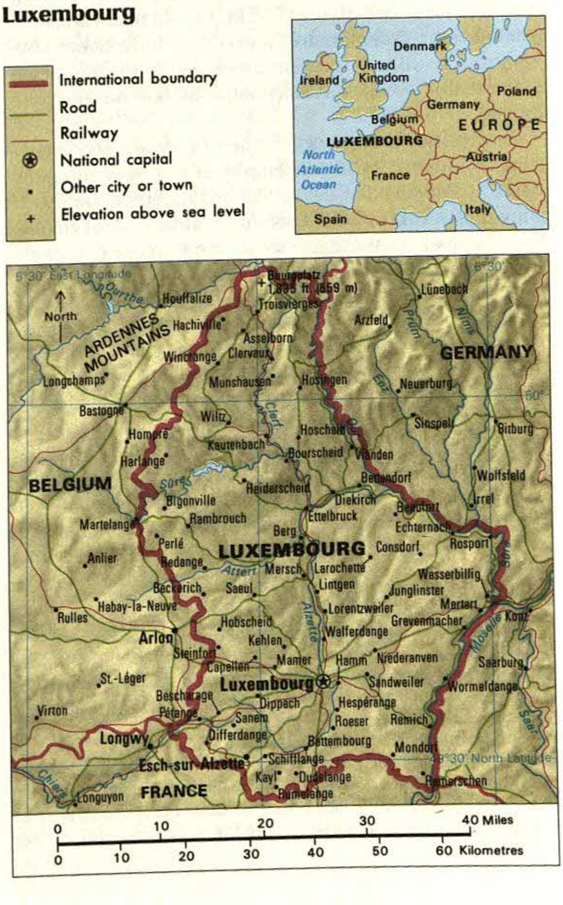
Pork and freshwater fish, especially trout, are favourite Luxembourg foods. Beer and wine are popular beverages. Many people live in charming villages where buildings constructed in the 1900's stand beside those dating from the 1100's, 1300's, and 1700's. The cities have many modern office and apartment buildings.

Luxembourg has three official languages: French, German, and Letzeburgesch. Letzeburgesch, a *dialect* (local form) of German, is a widely used everyday language. German is used in most primary schools, and French is used in most secondary schools. Newspapers are printed in German. French is used in the courts and parliament. Over 95 per cent of Luxembourg's people are Roman Catholics.

The law requires children between the ages of 6 and 15 to attend school. Luxembourg has an International University of Comparative Science and several technical and vocational schools. Almost all adult Luxembourgers can read and write.

Land. Luxembourg has two distinct land regions, the Ardennes and the Bon Pays (Good Land). The Ardennes cover the northern third of Luxembourg, and the Bon Pays makes up the rest. The Ardennes are part of a mountain system that extends from Germany's Rhineland into Belgium and Luxembourg. River valleys cut through the region's low hills. Buurgplatz, 559 metres high, a hill in the Ardennes, is Luxembourg's highest point. Most of the Bon Pays is a hilly or rolling plateau

Luxembourg



The city of Luxembourg is the capital and largest city of Luxembourg. The city lies on steep cliffs overlooking the Alzette and Petrusse rivers.

with level areas along its rivers. The Attert, Alzette, Moselle, and Sûre rivers flow through the region. The Bon Pays is an important farming region.

Most of Luxembourg has a cool, moist climate. The average temperature in the city of Luxembourg is about 0 °C in January and about 17 °C in July. Rainfall varies from about 100 centimetres a year in southwestern Luxembourg to 30 to 41 centimetres a year in the southeast of the nation. Most snowfalls occur high in the Ardennes.

Economy. Luxembourg is one of Europe's leading steel producers. Its largest employer is a steel company, Aciéries Reüniès de Burbach-Eich-Dudelange, better known as ARBED. ARBED produces almost all of Luxembourg's steel. Mines that provide the iron ore to make steel have decreased in number since World War II (1939-1945). Since the war—and especially since the general decline of steel production in the 1970's—the government of Luxembourg has worked to add variety to the economy. Luxembourg now has a number of high-technology industries. These industries produce such goods as computers and other electronic equipment. Many foreign companies have opened factories in Luxembourg that make such products as chemicals, plastics, and tyres. Numerous foreign banks have offices in the country. Tourism is also a major industry.

Facts in brief about Luxembourg

Capital: Luxembourg.

Languages: *Official*—French, German, Letzeburgesch.

Form of government: Constitutional monarchy.

Area: 2,586 km^2. *Greatest distances*—north-south, 89 km; east-west, 56 km.

Elevation: *Highest*—Buurgplatz, 559 m above sea level, in the Ardennes Mountains. *Lowest*—133 m above sea level on the Moselle River.

Population: *Estimated 1996 population*—398,000; density, 154 people per km^2; distribution, 86 per cent urban, 14 per cent rural. *1991 census*—384,062. *Estimated 2001 population*—411,000.

Chief products: *Agriculture*—barley, grapes, oats, potatoes, wheat, livestock. *Mining*—iron ore. *Manufacturing*—steel, chemicals, plastics, tyres, wine.

National anthem: "Ons Hemecht" ("Our Homeland").

Flag: The flag has horizontal red, white, and blue stripes (top to bottom). The colours come from the coat of arms of Luxembourg. Adopted 1845. See **Flag** (picture: Flags of Europe).

Money: *Currency unit*—Luxembourg franc. One franc = 100 centimes.

Farmers in the Bon Pays region grow barley, oats, potatoes, and wheat. They rear pigs and poultry and have fairly large herds of cattle and sheep. Grapes grown on terraces along the Moselle River produce good wine. Although about half of the total land is farmed, only 6 per cent of Luxembourg's workers are farmers.

Luxembourg is a member of the European Union, and trades chiefly with other members. Iron ore and steel production are major industries and make up about half of the country's exports. The chief imports are food and machinery.

Luxembourg has about 5,100 kilometres of roads. Its 270 kilometres of railways connect eastern France with Belgium. A major international airport is located just outside the capital.

History. Luxembourg was established as an independent state in 963, when Siegfried, count of Ardennes, gained control of the area and built a castle on the site of the present-day city of Luxembourg. In 1308, Henry VII, count of Luxembourg, became emperor of the Holy Roman Empire. His grandson, Charles IV, created the Duchy of Luxembourg in 1354. A period of prosperity began. Philip the Good of Burgundy conquered Luxembourg in 1443. In 1684, France took control of Luxembourg. Luxembourg became part of Spain in 1697. Austria gained control of it in 1714. In 1795, Luxembourg again became part of France.

In 1815, after the defeat of Emperor Napoleon I of France, the Congress of Vienna made Luxembourg a grand duchy that was technically ruled by the Netherlands. But Luxembourg was largely self-governing. In 1890, Wilhelmina became queen of the Netherlands. Luxembourg then broke away from the Netherlands and named its own monarch, because the grand duchy's laws did not allow a woman to rule. In 1912, the laws were changed to allow Marie Adélaïde of Nassau to become the ruling grand duchess. Her sister Charlotte succeeded her in 1919. In 1964, Charlotte abdicated to allow her son, Prince Jean, to become grand duke.

Germany occupied Luxembourg during parts of World War I (1914-1918) and World War II (1939-1945). In the winter of 1944 and 1945, part of the Battle of the Bulge was fought in northern Luxembourg. In 1945, Luxembourg became a member of the United Nations (UN). It joined an economic union called Benelux in 1948, and became a member of the North Atlantic Treaty Organization (NATO) in 1949. In the 1950's, Luxembourg helped found several economic groups. These groups form the basis of the European Community (EC), an economic association of European nations. In 1993, Luxembourg and the other EC countries formed the European Union, which works for both economic and political cooperation among its member nations. At that time, the EC became part of the European Union.

Today, Luxembourg plays an important role in European matters. The city of Luxembourg serves as the

Irrigated rice terraces at Banawe, in northern Luzon, are regarded as one of the wonders of the world. They have been developed and cultivated for more than 2,000 years.

headquarters of several agencies of the European Union, including the European Court of Justice and the administrative staff of the European Parliament.

Related articles in ***World Book*** include:

Benelux	Europe, Council of
Christmas (In the Netherlands, Belgium, and Luxembourg)	European Union
	Luxembourg (city)

Luxembourg (pop. 76,640) is the capital and largest city of the country of Luxembourg. For location, see the map with the **Luxembourg** (country) article. A picturesque city, Luxembourg stands on a plateau high above gorges formed by the Alzette and Petrusse rivers. Its landmarks include the Grand Ducal Palace, built in the 1500's; the Gothic Cathedral of Notre Dame, which dates from the early 1600's; and the town hall, built in the early 1800's. The Grand Ducal Palace is the residence of the country's monarch.

Luxembourg is the seat of several agencies of the European Union, including the European Court of Justice and the *secretariat* (administrative staff) of the European Parliament. The city is also an international financial centre. Many foreign banks have offices there.

Roman soldiers began constructing a fort at what is now Luxembourg in the A.D. 300's. In 963, Siegfried, Count of Ardennes, built a castle there, and a walled town grew up around the castle. Through the years, the walls were strengthened for defence against attacks. Gradually, much of the castle was destroyed. The walls were largely dismantled in the mid-1800's.

See also **Luxembourg** (country [picture: The city of Luxembourg]).

Luxemburg, Rosa (1871-1919), was a German socialist writer and revolutionary. She was a follower of Karl Marx, the founder of revolutionary Communism.

Luxemburg was born in Zamość, Poland, and became acquainted with Marx's writings after leaving school. At the age of 18, she fled to Switzerland to avoid arrest for political activities. Luxemburg received a doctorate in economics from the University of Zurich in 1898. That same year, she moved to Germany and joined the German Social Democratic Party. She became known as a brilliant writer and speaker.

Luxemburg spent most of the period of World War I (1914-1918) in prison for antiwar activities. She was released briefly in 1916. During this period, Luxemburg helped establish the Spartacus Party, a more revolutionary wing of the Social Democratic Party. The Spartacus Party was named after the leader of a slave uprising in ancient Rome. In 1918, Luxemburg helped found the German Communist Party and its newspaper, *Rote Fahne (Red Flag).* She was killed in mysterious circumstances by troops in Berlin.

Luxor. See **Egypt, Ancient** (map); **Obelisk.**

Luzern. See **Lucerne.**

Luzon (pop. 32,160,611) is the largest and most important island of the Philippines. Its population is more than half the nation's total population. Luzon is one of the northern group of islands. For location see **Philippines** (map).

The island covers an area of 104,688 square kilometres, more than one-third of the entire land area of the archipelago. Because of its size, Luzon is divided into six administrative regions.

The Ilocos region in the north is noted for its tobacco, rice, gold, silver, and copper. To the east of it lies the Cagayan Valley Region which has astonishing rice terraces at Banawe, which are regarded as one of the wonders of the world. The Central Luzon Region lies to the south. It is the main rice producing area of the Philippines. The National Capital Region, formerly called Metro Manila, lies to the south of the Central Luzon Region. This is the main economic, political, and social centre of the nation. It is the most densely populated region, with the national capital, Manila, and several other cities lying within its borders. Farther south is the Southern Tagalog Region. Rice, maize, sugar, coconuts, coffee, timber, minerals, oranges, and livestock are the major products. In the southeast of Luzon lies the Bicol Region. The varied landscape features volcanoes, plains, and the low-lying Bicol Valley. Most of its inhabitants speak the local dialect, Bicol. Typhoons frequently sweep over the region from the Pacific Ocean.

See also **Bicol** and **Manila.**

Lvov (pop. 728,000) is a major city of Ukraine. It is called *Lviv* in Ukrainian. The city is an administrative, commercial, industrial, and cultural centre of western Ukraine. Lvov also is an important transportation hub. For location, see **Ukraine** (map).

Lvov's major products include agricultural machinery, chemicals, electrical equipment, heavy vehicles, processed foods, and refined petroleum. Lvov has many museums, libraries, research institutes, and schools of higher education. The Ivan Franko University was established in 1611.

Lev, ruler of the independent principality of Galicia, founded Lvov in the 1200's (see **Galicia**). Poland controlled the city—spelled *Lwów* by the Poles—from the 1340's until 1772. From 1772 to 1918, Austria ruled Lvov. Austria renamed the city *Lemberg.* Poland retook the city after World War I ended in 1918. Lvov officially became part of the Ukrainian republic of the Soviet Union in 1945, after World War II ended. In 1991, Ukraine and other Soviet republics declared independence, and the Soviet Union ceased to exist.

Lycanthropy. See **Werewolf.**

Lycée. See **France** (Education).

Lyceum is an organization in the United States that sponsors lectures, concerts, and other adult educational programmes. The name comes from the school of Aristotle in Athens (see **Aristotle**). Josiah Holbrook started the American lyceum movement in 1826 in Millbury, Massachusetts.

The early lyceum movement aimed to improve schools and teacher preparation, establish libraries and museums, and improve American culture.

Lyceum was a gymnasium where boys and young men of ancient Athens received physical training and listened to the lectures of famous teachers. It stood outside the walls of Athens along the Ilissus River. It was near the grove sacred to the god Apollo Lykeios, after whom it was named. Aristotle established a famous school there about 335 B.C.

Lychee. See **Litchi.**

Lycopodium. See **Club moss.**

Lycurgus was a Spartan legislator. He is said to have set up the government that made Sparta the great military power of the Greek states. His birth and death dates and his exact achievements are uncertain.

Lycurgus probably lived during the 800's B.C., and was a member of one of the two Spartan royal families. The stories about him say he travelled to other parts of Greece, and to Asia and Egypt, to study their laws. On his return, he was asked to develop a new form of government for Sparta. The system he devised was designed to eliminate weaklings. Strict supervision from birth enforced discipline and military training. Lycurgus made his fellow Spartans promise not to change the system of government until he returned from another trip. Then he went into exile, and so forced the Spartans to keep the government he had planned.

See also **Sparta.**

Lyddite is an explosive mixture of picric acid and collodion. In the Anglo-Boer War, the British used lyddite to fill shells. The explosive known as TNT later proved more effective. See also **TNT.**

Lydia was an ancient country in Asia Minor. It was famous for its fertile soil and its rich mineral deposits, especially the gold of the Pactolus River. In the early 500's B.C., Lydia was an independent and prosperous kingdom. In about 545 B.C., the Persians conquered Croesus, the last king of the Lydians. Later, Lydia fell to the Macedonians and the Romans. Because Lydia lay at the western end of the great road connecting Mesopotamia and the East with the Aegean Sea and Greece, it was a great commercial centre. Lydia was one of the first countries to cast coins. Since 1958, archaeologists have been excavating Sardis, the capital city of Lydia. They have found sculpture and other artifacts, a synagogue, and a gymnasium complex. See also **Croesus; Phrygia; Cyrus the Great; Money** (The first coins).

Lye. See **Sodium hydroxide.**

Lyell, Sir Charles (1797-1875), a British scientist, is often called the founder of modern geology. Between 1830 and 1833, he published the three volumes of his *Principles of Geology,* which organized existing information about that science. Lyell showed in his book that the earth has changed slowly and gradually through the ages by means of processes that are still going on. Until the publication of Lyell's book, many people believed that changes in the earth had occurred in sudden upheavals.

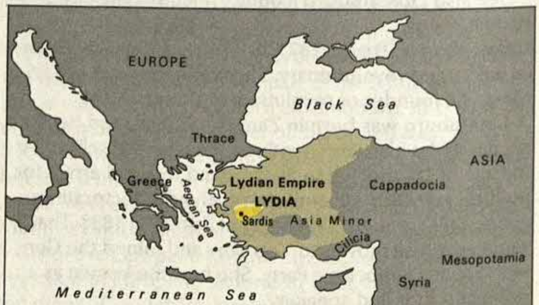
The book was so successful that Lyell spent much of his life preparing new editions and keeping them up to date. He was among the first scientists to accept modern theories about the Ice Age and evolution. His book *The Antiquity of Man* (1863) concerned prehistoric people in Europe. He also wrote *Travels in North America* (1845). Lyell was born in Kinnordy, Scotland.

See also **Geology** (Experimental geology).

Lyly, John (1554?-1606), was an English writer. He was important in the history of prose style and the development of Elizabethan popular comedy of high literary quality. Lyly was born in Canterbury, Kent. He established his literary reputation with *Euphues: The Anatomy of Wit* (1578), a fashionable book combining essay and fiction. Its artificial style, called *euphuism,* set a new pattern for sophisticated English prose.

Lyly turned to playwriting as part of an unsuccessful effort to further his advancement at court. His comedies treat idealized love and flatteringly reflect attitudes of the Elizabethan courtier. Written to be performed by troupes of boy actors, they emphasize style, song, and witty dialogue. *Campaspe* (1584) and *Endymion* (1588) are typical of Lyly's plays. Shakespeare's romantic comedies show the influence of Lyly's work.

Lyme disease is a bacterial infection transmitted by certain ticks. The disease is caused by *Borrelia burgdorferi,* a bacterium that infects several species of ticks found in woodlands, scrub, and grasslands. These ticks also are carried on the bodies of certain animals, especially deer and small rodents. People get Lyme disease after being bitten by an infected tick. The disease is most commonly transmitted in the warmer months.



Location of Lydia

The symptoms of Lyme disease vary in type and severity, making the illness difficult to diagnose. In most people, the first sign of infection is a rash that spreads from the site of the tick bite. The rash usually appears two days to two weeks after the bite. However, more than a fourth of the people infected do not develop a rash. Other early symptoms include fever, headache, fatigue, and pain in the muscles and joints.

Doctors use antibiotics to treat Lyme disease. When the illness is diagnosed and treated early, most patients make a full recovery. If untreated, the disease can lead to arthritis, heart abnormalities, and disorders of the nervous system.

People can reduce their risk of getting Lyme disease by taking precautions against ticks that transmit it. While in woody or brushy areas, people should wear long-sleeved shirts and long trousers tucked into socks to help prevent ticks from reaching the skin. The use of insect repellent also helps protect against tick bites.

Lyme disease has been recorded in Europe and in North America where, in the late 1980's, the disease affected more than 40 states in the United States.

Lymphatic system is a network of small vessels that resemble blood vessels. The lymphatic system returns fluid from body tissues to the bloodstream. This process is necessary because fluid pressure in the body continuously causes water, proteins, and other materials to seep out of tiny blood vessels called *capillaries.* The fluid that has leaked out, called *interstitial fluid,* bathes and nourishes body tissues.

If there were no way for excess interstitial fluid to return to the blood, the tissues would become swollen. Most of the extra fluid seeps into capillaries that have low fluid pressure. The rest returns by way of the lymphatic system and is called *lymph.* Some scientists consider the lymphatic system to be part of the circulatory system because lymph comes from the blood and returns to the blood.

The lymphatic system also is one of the body's defences against infection. Harmful particles and bacteria that have entered the body are filtered out by small masses of tissue that lie along the lymphatic vessels. These bean-shaped masses are called *lymph nodes.*

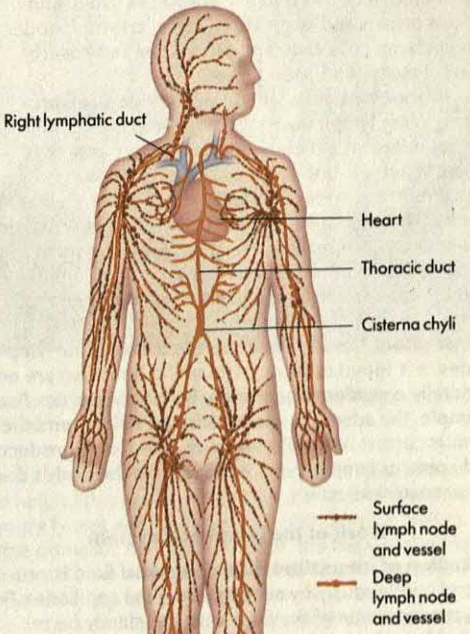
Parts of the lymphatic system

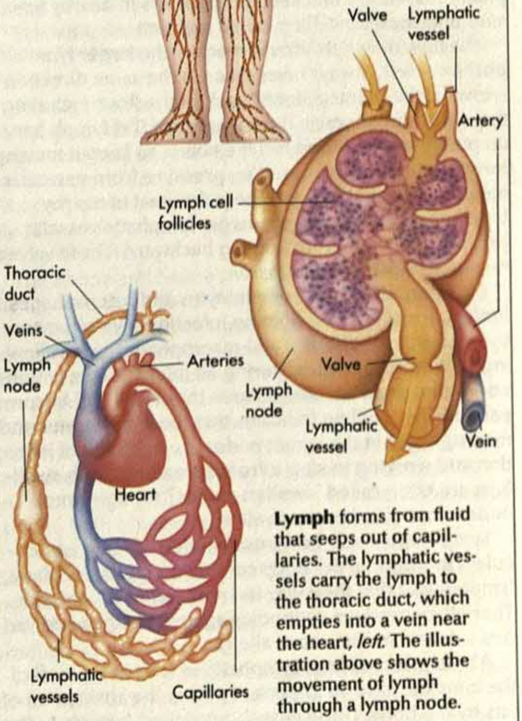
Lymphatic vessels, like blood vessels, are found throughout the body. Lymph flows from tiny vessels with many branches into larger vessels. Eventually, lymph from all but the upper right quarter of the body reaches the *thoracic duct,* the largest lymphatic vessel. The thoracic duct lies along the front of the spine. Lymph flows upward through this duct into a blood vessel near the junction of the neck and the left shoulder. Lymph from the upper right quarter of the body flows into the *right lymphatic ducts* in the right half of the chest. The lymph then drains from these ducts into the bloodstream near the junction of the neck and right shoulder.

Lymph is chemically much like plasma, the liquid part of the blood. But lymph contains only about half as much protein as plasma, because large protein molecules do not seep through blood vessel walls so easily as do some other substances. Lymph is transparent and straw-coloured.

The lymphatic system

The lymphatic system consists of a network of vessels throughout the body. Lymph nodes are found at various places along these vessels. Some nodes and vessels lie deep within the body, and others lie near the skin.





Lymph forms from fluid that seeps out of capillaries. The lymphatic vessels carry the lymph to the thoracic duct, which empties into a vein near the heart, *left.* The illustration above shows the movement of lymph through a lymph node.

Lymph nodes may be found at many places along the lymphatic vessels. They look like bumps and have diameters from 1 to 25 millimetres. The term *node* comes from the Latin word *nodus,* meaning *knot,* and lymph nodes resemble knots in a "string" of lymphatic vessels. The nodes are bunched together in certain areas, especially in the neck and armpits, above the groin, and near various organs and large blood vessels. Lymph nodes contain large cells called *macrophages* that absorb harmful matter and dead tissue.

Lymphocytes are a kind of white blood cell produced in the lymph nodes. They defend the body against infection. When abnormal cells or materials from outside the body pass into the lymph nodes, lymphocytes in the nodes produce substances called *antibodies.* The antibodies either destroy the abnormal or foreign matter or make it harmless. See **Immunity.**

Large numbers of lymphocytes are found in the lymph nodes and in lymph itself. They outnumber all other kinds of cells in lymph.

Lymphoid tissue resembles the tissue of the lymph nodes. It is found in some parts of the body that are not generally considered part of the lymphatic system. For example, the adenoids and tonsils, the spleen, and the thymus consist of lymphoid tissue. This tissue produces and contains lymphocytes, and it aids in the body's defence against infection.

Work of the lymphatic system

Return of interstitial fluid. Interstitial fluid is produced continuously by seepage from the capillaries. For this reason, some of the fluid must constantly be returned from body tissues to the bloodstream. If the lymphatic vessels are blocked, fluid gathers in nearby tissues and causes swelling called *oedema.*

The flow of lymph, after it reaches the larger lymphatic vessels, always takes place in the same direction —toward the thoracic duct. Much of the flow, including that within the thoracic duct, is upward. Yet lymph has no pump—as the blood has the heart—to keep it moving forward. The flow is caused by pressure from muscular movement, breathing, and the pulse beat in nearby blood vessels. Valves in the larger lymphatic vessels prevent the lymph from flowing backward. These valves resemble those in the veins.

Fighting infection. Lymphocytes and macrophages both play vital roles in fighting infection—lymphocytes by producing antibodies and macrophages by swallowing up foreign particles. During an infection, the lymph nodes that drain an infected area may swell and become painful. The swelling indicates that the lymphocytes and macrophages in the lymph nodes are fighting the infection and working to stop it from spreading. Such swellings are often called "swollen glands," though lymph nodes—not glands—are swollen.

Lymphocytes also flow into the bloodstream and circulate throughout the body combating infection. Many lymphocytes find their way to areas just under the skin. There they produce antibodies against bacteria and various substances that cause allergies.

Absorption of fats. Lymphatic vessels in the wall of the intestine have an important part in the absorption of fats by the body. These vessels are called *lacteals.* In the intestine, digested fats combine with certain proteins. The resulting particles enter the lacteals and give the lymph there a milky-white colour. This milky-white lymph is called *chyle.* The chyle passes through the lacteals to the *cisterna chyli,* an enlarged area in the lower part of the thoracic duct. Then the chyle and other lymph fluids flow through the thoracic duct into the bloodstream. Absorption of fats thus differs from that of carbohydrates and proteins, which blood vessels absorb and transport to the liver.

Rejection of transplanted tissue. Lymphocytes also take part in the body's rejection of tissue that has been transplanted from one person to another. They react against transplanted tissue in the same way that they do against other foreign material—by producing antibodies. After a person has received a transplanted organ, doctors reduce antibody production by destroying lymphocytes. However, this destruction reduces the patient's ability to fight infection.

See also **Blood; Elephantiasis; Hodgkin's disease.**

Lymphocyte. See **Blood** (White blood cells); **Lymphatic system.**

Lynch, John (1917-), was prime minister of the Republic of Ireland from 1966 to 1973 and again from 1977 to 1979. Lynch succeeded Seán Lemass as leader of the Fianna Fáil Party in 1966. In June 1977, he led his party to an election victory over Liam Cosgrave's coalition government. Lynch resigned his post in December 1979.

Lynch, often called Jack, was born in Cork. He studied at Christian Brothers schools there and at University College, Dublin. While working as a civil servant, he studied law at King's Inns. He began practising law in 1945 and won election to the Dáil for Cork in 1948. He held various posts under Eamon de Valera and Seán Lemass, including Minister of Industry and Commerce (1959-1965) and Minister of Finance (1965-1966).

Lynching usually means the killing, generally by hanging, of a person by a mob in defiance of law and order. Victims of a lynching do not have a chance to defend themselves. The mob simply assumes its victims are guilty, whether or not the victims have had a trial. Although similar mob violence has occurred in many countries at different times, the term lynching is particularly associated with the United States. Most U.S. states have attempted to stop lynchings by laws. Some states prosecute under the laws against homicide, riot, and assault. Other states have specific lynch laws. But legal controls have not succeeded in preventing lynchings altogether.

The term *lynching* probably originated with American planter Charles Lynch, who lived in Virginia during the 1700's. Lynch and his neighbours took the law into their own hands and punished *Tories* (British sympathizers) and others who plundered their property. The term came to be applied to physical punishment such as whipping and tarring and feathering.

In pioneer communities on the far western American frontier, many lynch mobs took the law into their own hands because there was no duly established legal authority. With the establishment of law and order throughout the United States, lynch mobs began to act in opposition to the law, instead of supporting it.

Before 1890, most lynching victims were white. Since then, most lynchings have occurred in the South, and the victims have usually been blacks. Of a total of 4,752 lynchings between 1882 and 1968, 1,307 victims were whites and 3,445 blacks. The peak year for these killings was 1892, with 230 victims. From 1957 to 1968, there were seven lynchings. No recorded lynchings have taken place since 1968. New England is the only part of the United States where no lynchings have occurred.

Lyndon B. Johnson Space Center. See Johnson Space Center.

Lyndsay, Sir David (1490-1555), was a Scottish poet who wrote mainly satirical verse in the common language of his day. *Testament and Complaynt of Our Soveraine Lordis Papyngo* (1530) is a series of criticisms of the Court and the Church, as if made by the king's parrot. Lyndsay was born near Haddington, Scotland.

Lynen, Feodor (1911-1979), a German biochemist, studied how cells produce cholesterol and other fatty substances known as *lipids.* High levels of certain cholesterol-containing molecules in the blood are a main cause of heart disease. Medical researchers have used results of Lynen's work to help prevent heart disease.

Lynen's experiments revealed the roles of certain *enzymes* (molecules that speed up chemical reactions) and the vitamin biotin in the formation of lipids. For this work, Lynen shared the 1964 Nobel Prize for physiology or medicine with Konrad Bloch, an American biochemist. Lynen was born in Munich.

Vera Lynn

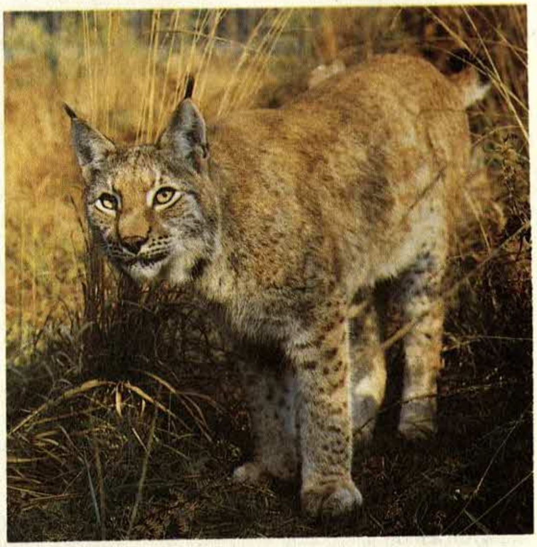
Lynn, Dame Vera (1917-), is a singer who won fame during World War II with her records and broadcasts. They became popular with British soldiers and earned her the title "Forces' Sweetheart." Among Vera Lynn's best-known songs were "We'll Meet Again" and "The White Cliffs of Dover."

Vera Margaret Lewis (née Welch) was born in London and first appeared on the stage at the age of 7. She sang with several dance bands in the 1930's and 1940's. Her career continued long after the war. In 1975, she was created a Dame Commander of the British Empire.

Lynx is a wild animal that belongs to the cat family. Lynxes are considerably smaller than such other wild cats as leopards and mountain lions. Most lynxes weigh from 5 to 10 kilograms. However, some lynxes weigh as much as 20 kilograms.

Lynxes live in parts of Africa, Asia, Europe, and North America. The *Northern lynx* ranges across North America. It was once common in Europe and northern Asia, but it is now scarce. The African lynx is called the *caracal.* It lives in the desert and mountainous regions of southern Africa, but it is now rare. The caracal is also found in Asia.

The lynx's fur grows long all over its body. The fur is light grey or greyish brown and long and silky. It is spotted and striped with a darker shade. Lynxes have stubby tails and long tufts of hair on their pointed ears.



The European lynx, like the other lynxes, is a large and powerfully built wild cat with tufted ears.

Lynxes live in forests or in rocky, brush-covered places. They hunt mainly at night and feed primarily on snowshoe rabbits and other small animals. Lynxes kill great numbers of harmful rodents and rabbits and so are helpful to people. When their usual prey is scarce, hungry lynxes will kill foxes and even deer, as well as some domestic animals. In winter, the huge feet of the lynx enable the animal to run swiftly over the snow.

Lynxes sleep in caves or hollow trees. They like to climb trees and lie stretched out on a limb. Young lynxes look like domestic kittens. The mother lynx bears from one to five babies in a litter.

Scientific classification. Lynxes belong to the cat family, Felidae. The Northern lynx is *Felis lynx.* The caracal lynx is *F. caracel.*

See also **Bobcat; Caracal; Wildcat.**

Lyon (pop. 422,444; met. area pop. 1,087,367) is the third largest city in France. Only Paris and Marseille have more people. Lyon lies in southeastern France (see **France** [political map]). The city serves as the capital of the Rhône *department* (administrative district) and the Rhône-Alpes region.

The Rhône and Saône rivers meet at Lyon, dividing the city into three parts. Busy docks and warehouses line the riverfront. Lyon's main commercial and entertainment district lies on a peninsula between the two rivers. On the west bank of the Saône is the oldest section of the city. It has narrow streets and tall houses.

The newest area of Lyon is on the east bank of the Rhône. It includes factories, a large university, and many attractive residences. Among Lyon's major landmarks are the Church of St. Martin d'Ainey and the Cathedral of St. Jean, both of which date from the 1100's.

Lyon is famous for the manufacture of textiles, especially silk and rayon. The city has many spinning, weaving, and dyeing plants. Other industries in Lyon produce cars, chemicals, metal goods, and such agricultural products as wine and cheese.

In 43 B.C., Roman soldiers established a colony on the site of what is now Lyon. During the 1400's, Lyon became a prosperous trading centre. The introduction of silk manufacturing from Italy during the 1500's brought greater, and long-lasting, prosperity. Lyon was a centre of French resistance to German occupation forces during World War II (1939-1945).

Lyon, Arthur Sidney (1818?-1861), was an Australian journalist who is considered to be the father of the Queensland press. He founded the first four newspapers in Queensland. They were the *Moreton Bay Courier,* in 1846; the *Moreton Bay Free Press,* in 1849; the *Northern Australian,* in 1855; and the *Darling Downs Gazette,* in 1856. Lyon was born in England. He worked on newspapers in Sydney and Melbourne before moving to Queensland.

Lyons was the name of two Australian politicians, husband and wife.

Joseph Lyons (1879-1939) was prime minister of Australia from 1932 to 1939. In the early 1930's, a dispute over economic policy caused a split in the governing Labor Party. Lyons resigned from the government and joined the opposition, the Nationalist Party, to form the United Australia Party. This party won an overwhelming victory in a federal election in late 1931, and Lyons became prime minister. The party lost seats in the federal election of 1934, but Lyons remained in office by forming a coalition with the Country Party. As prime minister, he helped the country recover from the economic depression that had begun in the late 1920's.

Joseph Lyons

Lyons was born on a farm near Stanley, in Tasmania. He qualified as a teacher in 1896, and entered the Tasmanian parliament in 1909. He was premier of Tasmania from 1923 to 1928. He entered the federal Parliament in 1929.

Dame Enid Lyons (1897-1981) was the first woman member of the House of Representatives. She entered Parliament as Liberal Party member for Darwin, Tasmania, in 1943. She was also the first woman to reach Cabinet rank. She was vice president of the Executive Council from 1949 until her retirement from Parliament in 1951. From 1951 to 1962, she was a member of the Australian Broadcasting Commission. Enid Muriel Burnell was born in Leesville, Tasmania.

Lyra, also called the Harp, is a small constellation that can be seen from the Northern Hemisphere. Its brightest star, Vega, is about 26 light-years from the earth. One light-year equals 9.46 trillion kilometres. Vega is the fifth brightest star visible, excluding the sun. For the location of Lyra, see **Astronomy** (map: The stars and constellations of the Northern Hemisphere).

Lyra has two notable features that can be seen through a small telescope. One of them is Epsilon Lyrae, a *binary star* (pair of stars). When viewed through a telescope, each of these bright stars in turn is double. A telescope also can spot the *Ring Nebula,* a ring-shaped cloud of dust and gas surrounding a very faint star. The nebula formed when the star blew off an outer layer of its atmosphere.

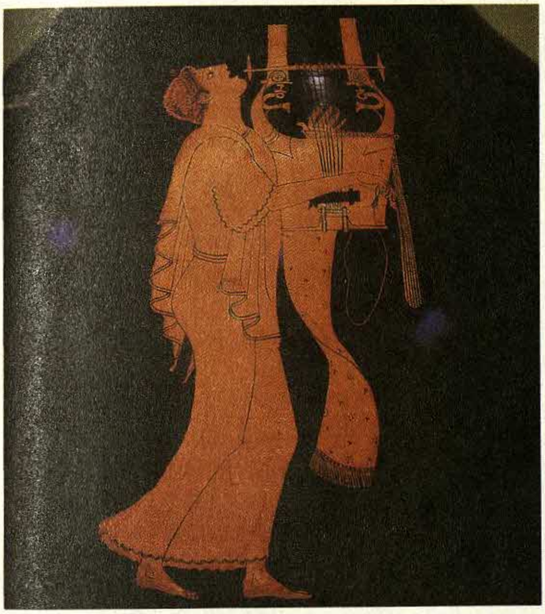
See also **Binary star.**

Lyre is an ancient stringed musical instrument that resembles a small harp. It has a bowl- or box-shaped frame with two arms extending upward. A crossbar is attached to the top of the arms. The instrument has 4 to 10 strings, which extend from the crossbar to the base of the frame. The player plucks the strings with the fingers of one hand or with a *plectrum* (pick). The fingers of the other hand press down on the strings to set the required pitch.

In Europe, some types of lyres are played with a bow instead of by plucking the strings. The sound of a lyre is amplified by a piece of cattle skin stretched tightly across the open side of the frame.

The lyre was especially popular among the ancient Greeks. The instrument was the symbol of Apollo, the Greek god of music and poetry. The Greeks used the lyre to accompany their songs and recitations. The words *lyric* and *lyrical* come from this use of the instrument.

Lyon's modern buildings include the Maurice Ravel Auditorium, *left.* Named after the famous French composer, the striking building is a concert hall that seats 2,000 people. It lies on the east bank of the Rhône River, in the newest area of Lyon.

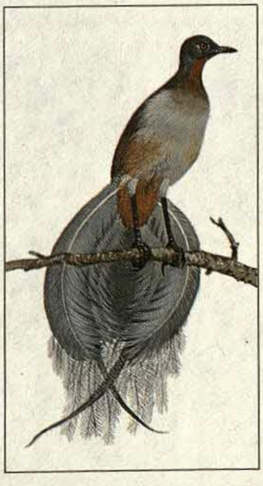


Red figure terra cotta vase; The Metropolitan Museum of Art, New York City

A boy playing a lyre was painted on a Greek vase of about 490 B.C. The lyre was a popular instrument in ancient Greece. It was the symbol of the god Apollo, patron of musicians and poets.

Lyrebird is one of the most unusual Australian birds. The tail of the male lyrebird has large and spreading feathers that are arranged like the ancient lyre. Two broad feathers curve upward with slender feathers in between. Normally, the tail is carried low. When the tail is raised and arched, it is about 60 centimetres long. Sometimes the tail is arched forward over the top of the bird's head. The lyrebird itself is only about the size of a chicken. The tail does not reach full growth until the bird is 7 or 8 years old.

The lyrebird has brown plumage. These birds have a strong, melodious song, and they can imitate the songs of other birds with remarkable accuracy. The lyrebird can fly, but it uses its wings for balance and for speed chiefly when running and leaping. The lyrebird makes its nest on the ground, and the female lays one egg in it.



Lyrebird

Scientific classification. Lyrebirds belong to the lyrebird family, Menuridae. There are two species, *Menura superba* and *M. alberti.*

See also **Bird** (picture: Birds of Australasia).

Lyric poetry. See **Poetry** (Lyric poetry); **Greek literature** (Lyric poetry).

Lysander (? -395 B.C.) was a statesman and general of the ancient Greek state of Sparta. He took command of Spartan military forces in the Aegean and the Hellespont late in the Peloponnesian War between Sparta and Athens. Through his friendship with Cyrus, son of the king of Persia, he persuaded Persia to help build and support a fleet. In 405 B.C., Lysander commanded the final battle of the Peloponnesian War at Aegospotami. In this famous sea battle, the new Spartan fleet, led by Lysander, destroyed the superior Athenian navy.

In charge of Sparta's foreign policy, Lysander established the government of Thirty Tyrants to rule Athens after the war. He also helped set up the government of *decarchies.* Decarchies were boards of 10 that governed in Greek states Sparta had freed from Athenian rule. Lysander was killed in battle in Boeotia in the Corinthian War.

Lysenko, Trofim Denisovich (1898-1976), was the most important biologist in the Soviet Union from the mid-1930's to the late 1950's. Soviet dictator Joseph Stalin supported Lysenko's theories for improving farm production because they promised quick success. However, Lysenko's theories proved to be faulty, and later Soviet leaders blamed them for slowing the growth of the country's agriculture. Lysenko held back Soviet research in *genetics* (the science of heredity) for more than 20 years.

Lysenko believed that new species of crops could be created from the old species by altering the crops' *environment* (surroundings) and affecting the phases of their life cycles. The resulting changes would be passed to the next generation, and create improved breeds, better adjusted to the conditions of their environment. Lysenko said, in effect, that organisms could be "trained" to change. He rejected the idea that units called *genes* determine heredity. His ideas have been rejected by present-day biologists.

Lysenko was born in Karlovka, a village near Poltava. His parents were farmers.

Lysergic acid diethylamide. See **LSD.**

Lysias (459?-380? B.C.) was a great orator of ancient Greece. He wrote more than 200 speeches and helped establish the study of oratory.

Lysias was born in the Greek colony of Syracuse in Sicily. His father was a wealthy shield manufacturer. Lysias moved to Athens in Greece and became a strong supporter of that city's democratic government.

Nearby Sparta conquered Athens in the Peloponnesian War (431-404 B.C.). The Spartans installed a powerful group of men, known as the *Thirty Tyrants,* to govern Athens. Lysias was arrested by the government because of his wealth and democratic beliefs, but he escaped into exile.

Lysias returned to Athens when democracy was restored in 403 B.C. That year, he attacked the cruelty and corruption of the Thirty Tyrants in one of his most famous speeches, "Against Eratosthenes."

Lysippus (380's?-306 B.C.?) was one of the greatest sculptors of ancient Greece. Most of his works were masculine, athletic statues of victors from the great sports festivals at such sites as Olympia, Isthmia, and Nemea. Lysippus idealized his subjects, raising them to godlike, heroic figures. He was equally brilliant at creating both small, delicate works and statues of vast size and grandeur.

A marble statue attributed to the ancient Greek sculptor Lysippus, typical of the heroic male figures he created.

Lysippus was born in Sicyon in the Peloponnesus. He was influenced by Polyclitus, a Peloponnesian sculptor of the 400's B.C. Like Polyclitus, Lysippus preferred to work in metal instead of the traditional marble. Lysippus' style went through several stages, beginning with the realistic imitation of nature. Later, his style was described as being more impressionistic. Ancient sources credited Lysippus with 1,500 works. However, only one work by the sculptor may have survived. This work is a bronze statue of an athlete that some scholars have attributed to Lysippus. It stands in the J. Paul Getty Museum in Malibu, California, U.S.A.

Lysosome. See **Cell** (The cytoplasm; diagram: The structures of a cell).

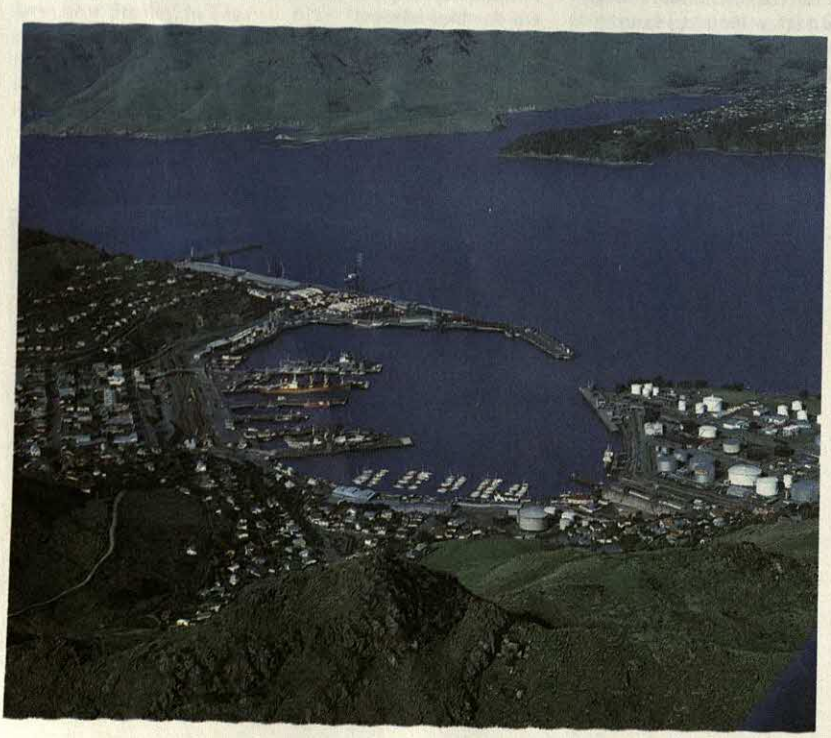
Lyte, Henry Francis (1793-1847), a British clergyman, is best remembered for the hymns he wrote. These hymns include "Abide with Me", "Jesus, I My Cross Have Taken." and "Praise, My Soul, the King of Heaven." For 25 years, Lyte served as clergyman in the small fishing village of Lower Brixham, on the Devonshire coast. He also worked as a clergyman in a parish near Wexford, Ireland, and in the English parishes of Marazion, Corwall; Lymington, Hampshire; and Charlton, Devon.

Lyte wrote his most famous hymn "Abide with Me," in 1820 after visiting a dying friend at Pole Hore, near Wexford. Sung to the tune "Eventide" by the British organist W. H. Monk, it is one of the most moving of British hymns. Lyte was born in Ednam, near Kelso in southern Scotland. He was ordained as a minister in the Anglican Church when he was 21 years old.

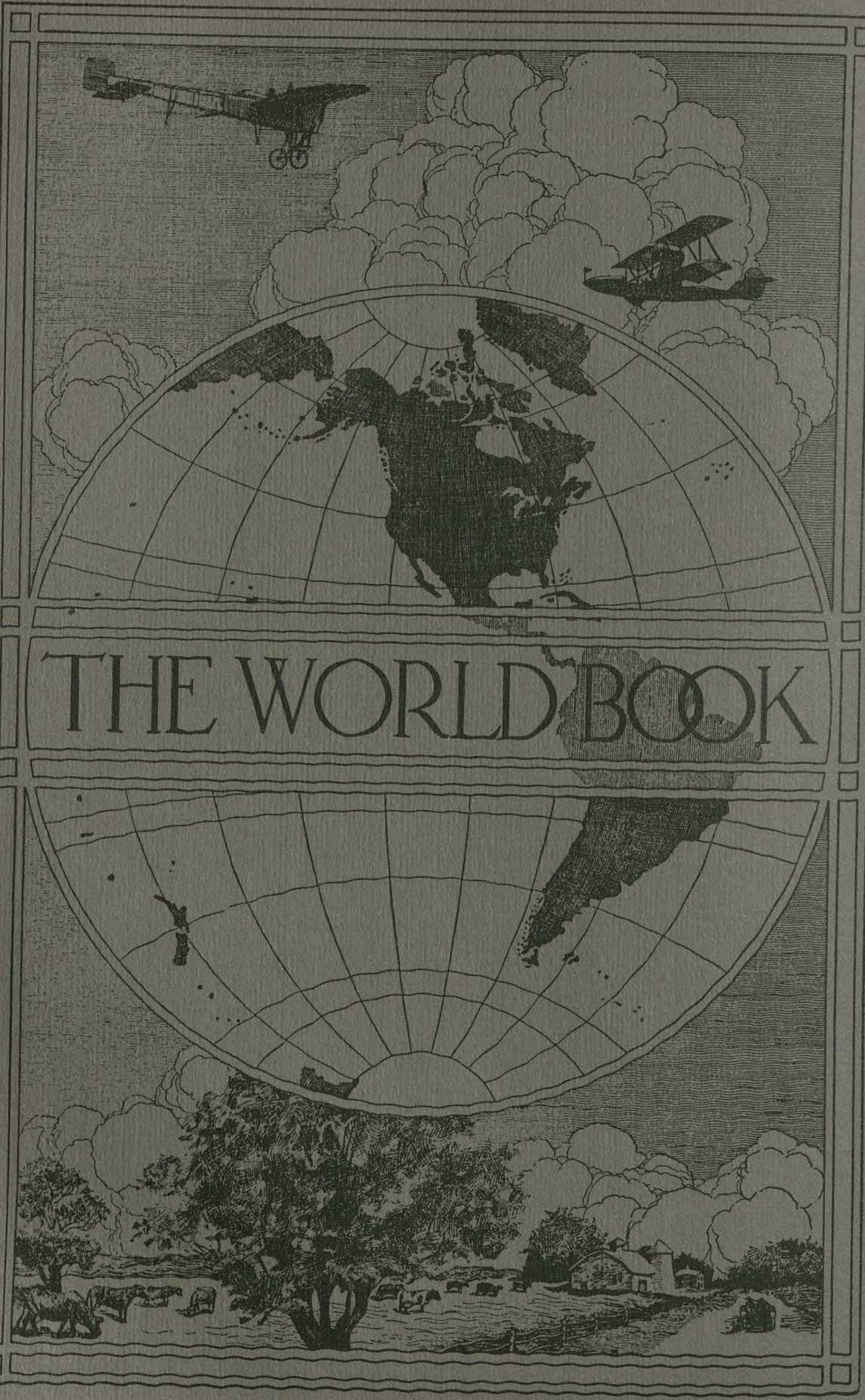
Lyttelton (pop. 3,200) is a town and port on the eastern coast of the South Island of New Zealand. It is the main port serving the city of Christchurch and Canterbury province and is the largest and busiest port in the South Island. Each year it handles more than 2 million metric tons of cargo. The greater part of the town is built on steep slopes. Much of the lower area is built on reclaimed land.

Lytton, Baron. See **Bulwer-Lytton, Edward George Earle Lytton.**

LZ-1. See **Airship** (The Zeppelins).



An aerial view of the town and harbour of Lyttelton, on New Zealand's South Island. Lyttelton is about 11 kilometres southeast of Christchurch. It is the island's main port, and is able to handle large tankers and other ships.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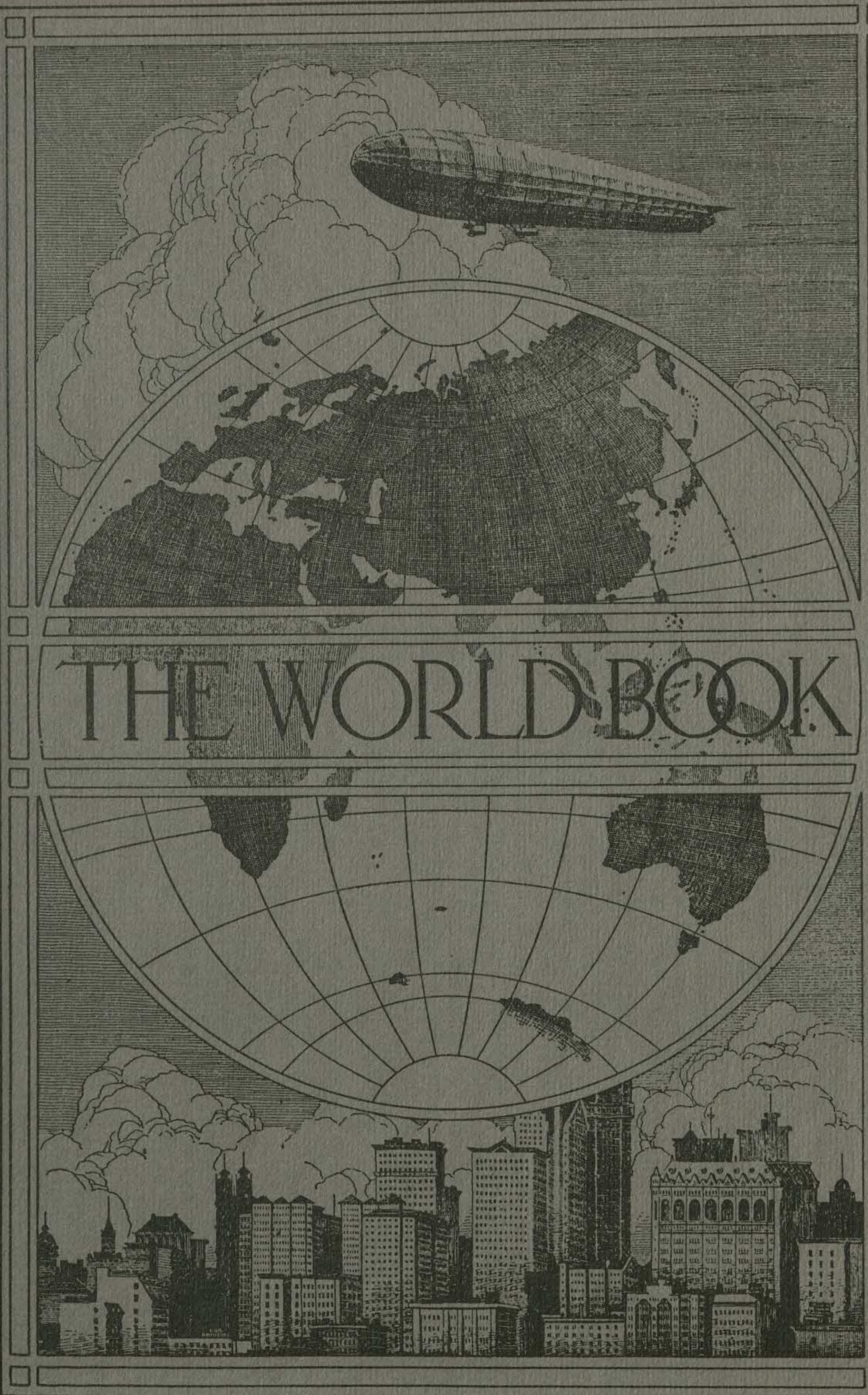
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